


# As It Seems To Us

## A RECORD FOR CONCRETE

 JUST to find out how the facilities that have been set up for placing concrete in Hoover Dam would work under full pressure, F. T. Crowe, general superintendent for Six Companies Inc., recently threw the organization into high gear during a 24-hour period. The result was the obliteration of all existing records for pouring concrete on a construction job. A total of 6,150 cubic yards was placed in the dam proper, and enough besides in the Arizona spillway to bring the aggregate up to more than 7,000 cubic yards.

This was said to be more than twice as much concrete as had ever been handled theretofore within a day's span. The performance was considered all the more remarkable because it was accomplished under partially restricted conditions. Only 87 columns of the 232 that will go to make up the completed dam had been started at the time; and the possible pouring areas were accordingly greatly limited as compared with what they will be later on. Because of this fact, Mr. Crowe predicted that the record established during the test run would be considerably exceeded before the great concrete monolith attained its ultimate height.

His prophecy came true sooner than probably even he expected, for a little more than two weeks later a new mark was set. This time the dam workers placed 6,931 cubic yards of concrete in the river barrier and 239 cubic yards in the Arizona spillway, making a total of 7,170 cubic yards for the day. By the time these words reach the reader, even this latter figure may be only a former record.

On the occasion of the setting of the two marks cited, all three aerial cableways available at the dam site for handling concrete were kept busy continually. Of the three shifts employed, the swing shift—intermediate between the day and night crews—carried off the palm by pouring a total of 2,393 cubic yards.


If converted into concrete highway 20 feet wide and 10 inches thick, the material poured on either of the days mentioned would lay a strip more than two miles long. Concrete is now being placed at Hoover Dam at about twice the best rate reached during the lining of the diversion tunnels, when the highest record for a day was around 3,000 cubic yards.

During July, when work on the dam itself really got underway, approximately 100,000 cubic yards of concrete was poured. The predicted total for August was 120,000 cubic yards, but the actual amount handled was 160,000 cubic yards, or at the rate of 5,207 cubic yards a day.

The tentative schedule of construction outlined by the Bureau of Reclamation engineers calls for the pouring of an average of 3,500 cubic yards a day throughout the 32 months allotted for the rearing of the dam.

In view of the accomplishments just reviewed it is easy to foresee that Six Companies Inc. will do this phase of the work in its accustomed way—that is, much faster than called for in Uncle Sam's program.

## ANOTHER HUGE PROJECT

 BIG AS the Hoover Dam development is, there is promise of another water-conservation scheme in the West that will rank with it in some of its aspects. The State of California is sponsor for this new undertaking, and the legislation authorizing it has been already enacted.


The idea behind the plan is to transfer water from the Sacramento River, where there is a plentiful supply, to the San Joaquin Valley, where there is a shortage. This will involve extensive works, chief among which will be a dam near the point where the Pitt and McCloud rivers meet just before flowing into the Sacramento. Appurtenant structures will include power-generating plants which will furnish the electricity for pumping the impounded water over the divide to the San Joaquin. Surplus power will be transmitted to the San Francisco district for sale there.

The main dam will rise to a height of 420 feet, and will create a reservoir having a surface area of 23,000 acres at high water. In point of concrete required this structure will be the equal of the Hoover Dam, although it will be considerably lower than the Black Canyon barrier.

There will be dams also on the San Joaquin to impound the water in its lower stretches so that it can be pumped to higher land and there distributed to areas which now threaten to revert to the desert because of a lack of irrigating water. These dams will cause the lower San Joaquin River to become dry; but the transfer of excess water from the Sacramento will renew the flow and thereby fill the needs of consumers contiguous to the San Joaquin. A canal at lower levels will reclaim considerable delta land from encroaching salinity—a result of the invasion of bay waters, and will also furnish fresh water to manufacturing plants in the bay area.

This scheme is not a new one. Engineers have pondered over it for many years, and have had their data in order awaiting an auspicious time to arrange the fiscal details. The availability of Reconstruction Finance Corporation funds has set the well-laid plans for its consummation in motion. The entire project will entail an estimated cost of \$170,000,000. It is expected that the Federal Government will make an outright contribution of \$48,000,000 towards this sum under the provisions of the new public-works program and also because the undertaking involves flood control of navigable streams.

## POWER PLANTS IN THE EARTH

 STEAM issuing from the ground will be used to provide the electrical energy which will be needed to propel cars over the new 160-mile railroad between Rome and Florence, Italy. Natural steam and hot water have been put to many useful purposes in various parts of the world for years, but this marks the first effort to harness subterranean energy to railway wheels.

In the November, 1931, issue of this magazine there is a description of the development of the natural-steam resources of Larderello, in Tuscany. The steam makes its presence known by escaping through openings, known as *fumaroles*. By tapping the underground reservoirs with 10-inch drill holes and casing them, it was found possible not only to increase the volume of the steam but also to control its flow, as desired.

In this section of Italy there is an area of some 100 square miles under which steam is constantly being generated. The popularly accepted scientific explanation of this phenomenon is that circulating ground waters come in contact with immense bodies of molten rock which, if they reached the surface, would constitute volcanic action. The steam follows fault planes and fractures in the overlying rocks—its own pent-up force helping to form the vents through which it ultimately escapes into the atmosphere. Thus new *fumaroles* are caused to appear at the surface from time to time.

The success achieved in this respect in the Larderello area is said to have prompted the attempt to develop sufficient power elsewhere for the operation of the new railroad, the electrification of which is being carried out by the Italian government. The newest of these steam wells, which is near Livorno, or Leghorn, on the western coast of Tuscany, is reported to deliver about 220,000 pounds of steam an hour at 59 pounds pressure per square inch and at 374° F. Together with steam from two other wells, recently driven, it will be capable of providing some 20,000 kw. of electrical energy.

Steam from the Italian *fumaroles* contains considerable quantities of boric acid and has been exploited for the recovery of that substance for more than a century. Means have been developed of late for the extraction also of its ammonia content, and for capturing carbon dioxide gas, which occurs in considerable quantities.

In Alexander Valley, about 100 miles from San Francisco, Calif., much work has been done in recent years towards utilizing the steam and hot water expelled from the geysers in that region. Already, these efforts have reached commercial proportions, and they are being continued with the idea of perhaps ultimately supplying heat and light to San Francisco.



## From First to Last with "Caterpillar" Tractors

PAUL C. SMITH

AN automobile rumbled across the bridge that leads from Stockton, Calif., to Roberts Island, and with a honk from its shiny brass horn and a bounce of its high tonneau it turned off the main road into a long lane. All the way from town horses had shied at it and their drivers had stared, for automobiles were still quite a curiosity in 1905. But the two men on the front seat had been oblivious to this commotion as they passed. Their thoughts were focused on the important events that lay ahead. Finally their mutual impatience to reach their destination was voiced by the man seated beside the driver, "When are we going to get there, Mr. Holt? Seems like we've come 30 miles already." "Just a minute now," replied his companion. "Better be getting your camera and plates together."

As the two men left the car and started across a great field, a strange object could be seen slowly moving along the horizon. It had the familiar smokestack and boiler of the steam traction engines of that day, but on each side were two contrivances that looked at a distance like wide belts turning around narrow pulleys. It was a new and startling sight to Charles Clements, the photographer, but every inch of the mechanism was familiar

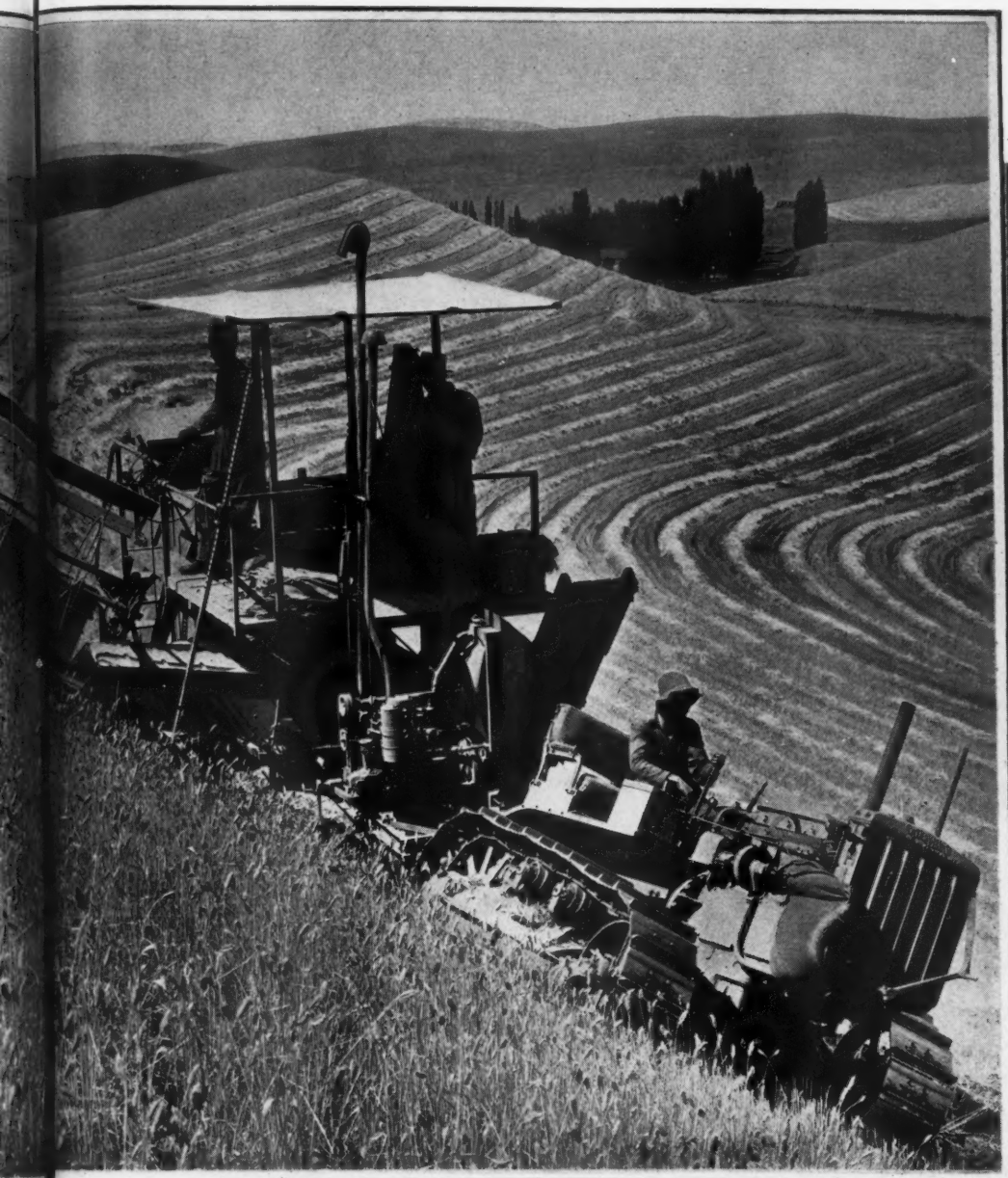
to Benjamin Holt, for he and his nephew, Pliny Holt, had fashioned it with their own hands in a workshop behind the factory of The Holt Manufacturing Company in Stockton. It was the result of a 20-year search for a machine that would work on the soft peat soil of the San Joaquin Valley. It traced its development back to 1883 when Benjamin Holt and his three brothers—Charles, Frank and Harrison, located in Stockton and organized the Stockton Wheel Company. Starting with wagon wheels, they were soon building wagons, and before many months had passed they had turned their attention to the combine harvester which was then in the early stages of its development. By 1885 they had perfected a successful combine, and that year sold several of them for use on the grain ranches of the San Joaquin Valley. Those early machines had a ground drive similar to that used on the binders of today, but, owing to their great weight and the large amount of mechanism to be driven by the bull wheel, it took a large number of horses to pull them. But the combine proved popular with the big grain farmers, although some of them complained that the machines were too heavy to be operated by horses during the intense heat of harvest time.



All this led to a demand for a tractor that would pull the combine and do plowing and similar heavy work at other seasons of the year. To meet this demand, Daniel Best, who also had been manufacturing combines at his factory in San Leandro, Calif., started work on a steam traction engine and combine. Both of these machines were placed on the market in 1889, and were quite successful on the high, dry ground between the foothills and the coast.

About the same time The Holt Manufacturing Company began work on similar machines, and by 1891 it had built steam traction engines and combines which were used that year on some of the large grain farms near Stockton. But most of those farms also adjoined the San Joaquin River, and were therefore largely composed of very soft delta soil. When the soil was dry the new machines were quite satisfactory, but when it was wet there was trouble. Anyone who has attempted to dig





#### "CATERPILLARS" AT WORK

Probably no more expressive name was ever applied to a piece of machinery than that which was happily chosen for these sturdy, crawling engines that have become familiar objects wherever heavy loads are drawn over uneven terrain. In the abbreviated lingo of the construction camp they are simply "Cats". The central picture shows a combine and tractor harvesting wheat on the steep hills of the Palouse country, near Pullman, Wash. Flanking it on either side are "Caterpillars" engaged in Mississippi flood prevention work. The photographer caught the four machines just as they topped the crest of a levee pulling loaded 10-cubic-yard wagons of dirt.

a steam traction engine out of the mud will know what this trouble was; and, from the first, it was evident that miring and wheel slippage had to be overcome if the machines were to be successful.

The cure seemed simple. If comparatively narrow wheels sank down, why not make them wider? Bigger and better wheels became the slogan of those early tractor builders, and many of us can still remember some of the wheels that adorned their machines. They were high and wide, if not handsome; but it is doubtful if any manufacturer carried the wide-wheel idea to such an extreme as did The Holt Manufacturing Company in the case of the tractor built in 1898 for Charles Moreing. This machine had drive wheels 8 feet in diameter and 18 feet wide. Each wheel was in three sections, and a huge "A" frame towered skyward to hold the tractor together and the wheels in place.

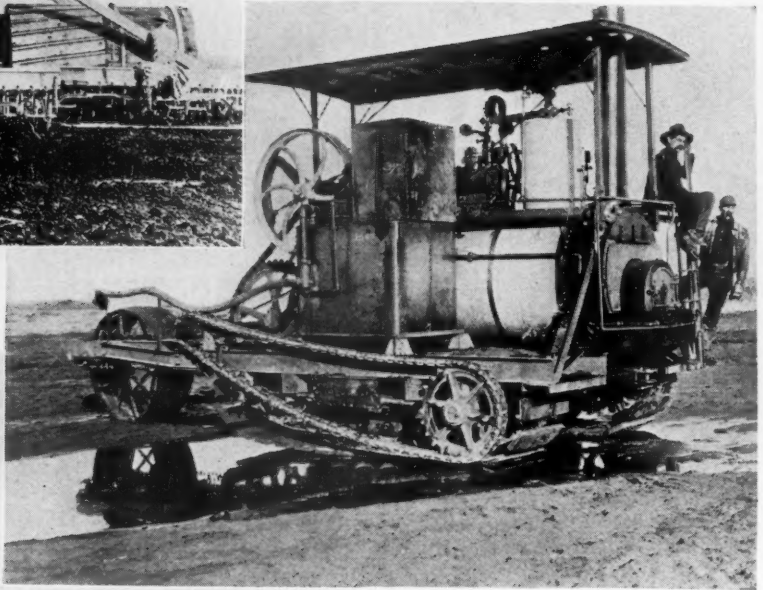
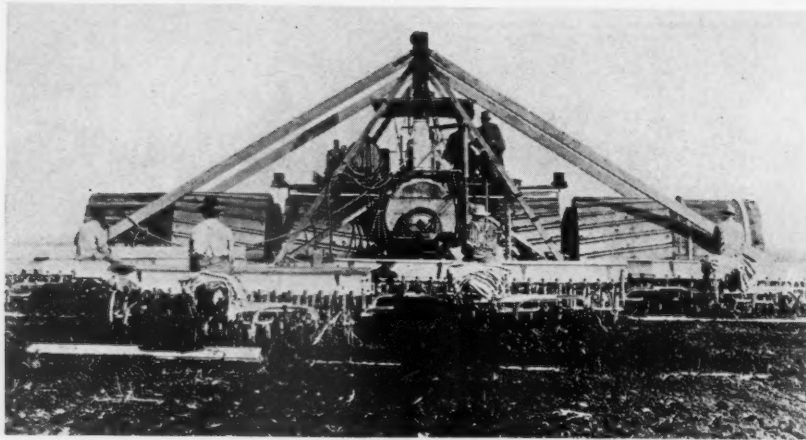
But even this machine suffered from the

old complaint. In the soft spots it slipped and mired down because with the widening of the wheels the weight was increased at almost the same rate as the traction. Of course, the tractor had many other serious disadvantages. Imagine maneuvering a tractor with drive wheels 36 feet wide around a barnyard or an ordinary field. Imagine housing it, caring for it, and moving it from job to job along the roads and bridges that existed in the 90's, and imagine pulling it out when it mired down! Then you will understand why Benjamin Holt was forced to the conclusion that wheels would not bring him to the goal he sought. He had built them to almost unbelievable size only to learn that they still lacked ground contact and traction.

But what was he to use? There was no other way of moving loads over the ground. From the day primitive man fashioned the first crude cart with sections of logs for wheels there had been no rival or substitute for the

wheel. Now wheels had failed, and something would have to be created to take their place. For a time Mr. Holt was in despair. Scores of ideas presented themselves and were discarded. Then one day a happy thought struck him. His mind harked back to his grandfather's farm in New Hampshire, and he saw the mouse-colored pony patiently working the treadmill. That was it—an endless track like a treadmill! Why hadn't he thought of that before? Such a track would stop wheel slipping, soil packing, and miring because it would spread the weight of the machine over a bigger area; and it could be revolved by a sprocket and thus picked up to be used again and again. At last he seemed to be making real headway in solving his perplexing problem.

He could hardly wait to get started on the new machine. Only his nephew and assistant, Pliny Holt, was told what he planned to do, and the two men spent every spare moment in a secret workshop behind the Stockton factory. Often they toiled far into the night, but slowly their efforts bore fruit. First came an experimental set of tracks or "platform wheels," as Mr. Holt originally called them. Then followed the first track-type tractor with its steam engine, its double-chain drive, and its tracks made of wooden blocks



#### BUILDING NEW ROADS

"Caterpillars" help carve new highways through both dirt and rock. Above, a diesel tractor and power-controlled elevating grader are shown loading dirt into wagons in St. Croix County, Wisconsin. At the right "Jackhammer" men are pictured at work on the Smoky Mountain Highway along the North Carolina-Tennessee boundary, using air from a Type 20 portable compressor drawn by a "Caterpillar."



#### EVOLUTION OF THE "CATERPILLAR"

Aiming to make a tractor that would not slip or mire down in soft ground, The Holt Manufacturing Company in 1898 built the ponderous engine at the top left. Each 3-section wheel was 18 feet wide and the machine was much too heavy. Benjamin and Pliny Holt solved the problem when, in 1905, they assembled the first crawler-type tractor (above right). A modern, diesel-engine "Caterpillar" is shown in the center. It is pulling a 24-disc gang plow.

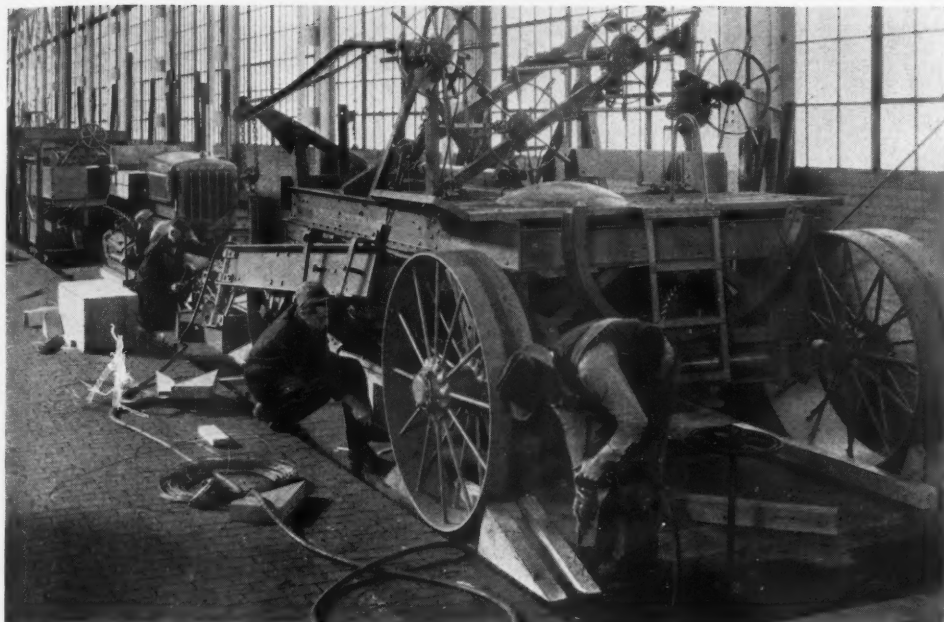
fastene  
this tr  
over it  
onstrat  
the spr  
Holt M  
drivers  
There  
new "  
steam

The  
8-botto  
difficul  
Then t  
tractor  
slowly  
linders  
no app  
ward v  
high on  
sign of  
for a sn  
would  
notch,  
parent  
progres  
loads h

This  
vincing  
with th  
had be  
the loa  
ed all t  
to the  
belled:  
the bi  
were d  
opport  
was wa  
of the  
where  
antly  
there l  
of the  
engine  
60-hp.  
Thu

Comp





#### THE FACTORY FAREWELL

Even to the final operation of blocking them upon flat cars with nails driven by a chipping hammer, compressed air plays a leading rôle in the manufacture and assembly of "Caterpillar" tractors and graders in the huge factory at Peoria, Ill.

fastened to a heavy endless chain. It was this tractor that established its superiority over its wheeled brothers in the secret demonstration that was held on Roberts Island in the spring of 1905. Only the officials of The Holt Manufacturing Company, the tractor drivers, and the photographer attended. There were two tractors on the scene—the new "Caterpillar," powered with a 40-hp. steam engine, and a 60-hp. wheel tractor.

The wheel machine was first hooked to an 8-bottom gang plow which it pulled with some difficulty, especially across the low spots. Then the plow was hooked to the track-type tractor. Amid tense silence the throttle was slowly opened. Steam hissed from the cylinders, and the tracks started to turn. With no apparent effort the tractor marched forward with its heavy load. The tracks rode high on top of the springy soil. There was no sign of miring or slipping. The driver headed for a small pond, just to see what the machine would do. He dropped the plows to the last notch, but the tractor did not hesitate. Apparently nothing could stop the relentless progress of this machine—mud and heavy loads held no terrors for it.

This test was encouraging but not convincing. The tractor could not walk away with the honors so easily. Four more plows had been provided: they would add those to the load and see what happened. They hooked all twelve first to the wheel tractor and then to the "Caterpillar." But the wheeler rebelled: it moved the load a few feet and then the big drivers started to slip. Soon they were down almost to the axle. This was the opportunity for which the track-type tractor was waiting. It not only pulled its rival out of the mud but hooked onto the plows just where they had been left and walked triumphantly away with them. No longer could there be any question as to the superiority of the new machine. With only a 40-hp. engine it had outpulled and outperformed a 60-hp. wheel tractor.

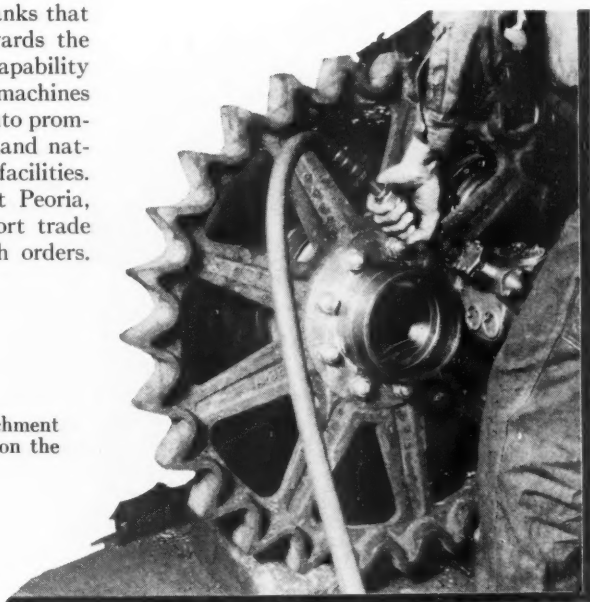
Thus the first track-type tractor proved its

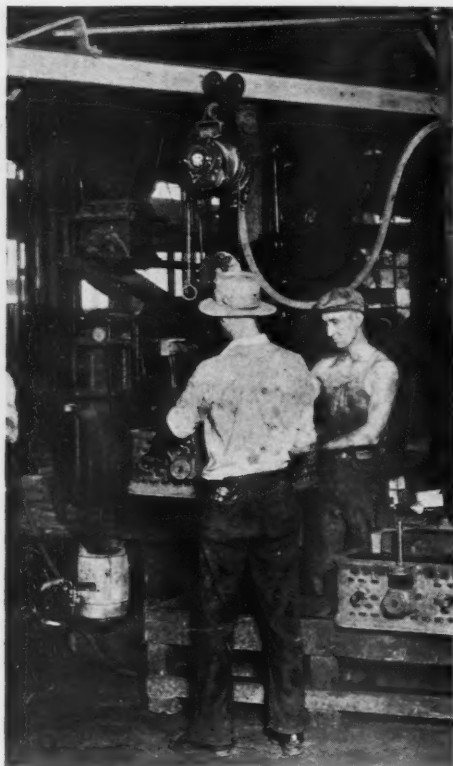
worth in 1905. So convincing was its demonstration that wheel tractors were soon dropped from production and all the facilities of The Holt Manufacturing Company were concentrated on the track-type machine. Improvements came in rapid succession—gear drives supplanted chains, steel replaced wood in the track shoes. A gasoline model was developed; and by 1908 a fleet of these machines won notice by hauling supplies across the Mojave Desert to build the Los Angeles Aqueduct.

The use of the "Caterpillar" tractor became widespread. In tropical jungles, on desert caravans, and across the icy wastes above the Arctic Circle, the machines made records for themselves. Farmers and roadbuilders found many applications for them. Loggers and miners bought them for difficult hauling jobs. When the first dull rumblings of the great war shook the world, in 1914, "Caterpillar" tractors were soon in the thick of the fight. More than 10,000 of them were built and sold to the Allies for war work. Their performance and design were the inspiration for the tanks that played such an important part towards the close of hostilities. Their amazing capability of pulling big loads where other machines couldn't travel light, brought them into prominence the world over. Such a demand naturally called for more production facilities. The factory that had been built at Peoria, Ill., to supply the eastern and export trade suddenly found itself swamped with orders.

#### AIR WRENCH

An air drill fitted with a wrench attachment speeds the work of running up nuts on the bolts of a sprocket.





tion, for the tractor's job is always a hard one. Frequently a machine has to work day and night pulling a capacity load under extremely difficult operating conditions. Years of this kind of service call for the finest materials and the most exacting factory methods; and from that day in 1905 when the first track-type tractor proved its worth, the aim of the builders of "Caterpillar" tractors has been to improve their machines so they might yield the greatest possible profit and satisfaction to their owners.

In its big plant at Peoria, Caterpillar Tractor Company has installed the most modern



### HOISTS EVERYWHERE

Among the many functions that compressed air machinery fulfills in bringing tractors and allied machinery into being, none is more important than the movement of materials with air hoists. These machines are used in practically every department. In the foundry (left) they handle mold covers and cases. Here also, compressed air cleans patterns, sprays surface sand, and operates molding machines. In the cleaning department (above), castings are moved by hoists into position for trimming with chipping hammers, after which they pass on a monorail to

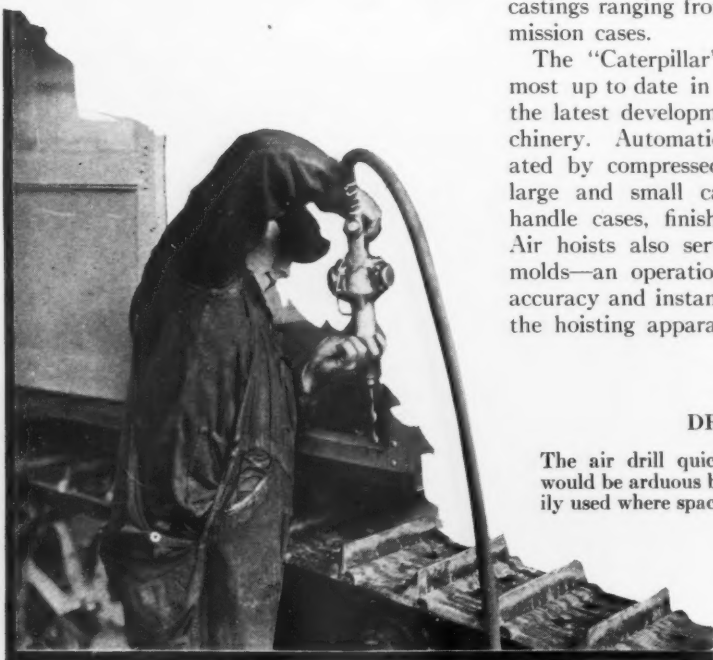
equipment to perform every operation and to insure the highest standards of quality and workmanship. Manufacturing care starts with the raw materials and follows each machine even after it is placed in the hands of the owner. The metallurgical laboratory subjects every metal part, from radiator to drawbar, to searching examination. Steels are tested for hardness, chemical purity, tensile strength, reaction to heat treatment, resistance to shock, and physical structure. Cast iron is similarly handled. Even such comparatively small parts as bolts and cotter pins must prove their fitness in the laboratory.

When the raw material has been thus approved it is sent to the factory, where it goes through the required processes that eventually bring it to the assembly line ready to take its place in the tractors. If this material be iron, it is delivered to the foundry where it is mixed with other metals and loaded into cupolas to be melted and poured into the hundreds of molds that form a wide variety of castings ranging from radiator caps to transmission cases.

The "Caterpillar" foundry is one of the most up to date in the world, and employs the latest developments in labor-saving machinery. Automatic molding machines, operated by compressed air, are used for both large and small castings, while air hoists handle cases, finished molds, and castings. Air hoists also serve to close most of the molds—an operation that calls for extreme accuracy and instant response on the part of the hoisting apparatus. Cores are removed

### DRILLING

The air drill quickly performs work that would be arduous by hand, and can be readily used where space is restricted.



from the larger castings by means of a stream of water, under tremendous pressure, which is played upon them from outside of a revolving steel chamber. When these castings are free of core sand, then power grinders and pneumatic chippers dress them smooth—the polishing being completed in a Pangborn sand-blast room where compressed air again comes into action. Ingersoll-Rand hoists lift each casting onto a circular trolley on which it is pushed through steel doors into a steel-walled, windowless sand-blast chamber. Overhead, electric lights shine through swirling clouds of sand that are driven from a heavy hose by a blast of compressed air. A shadowy figure dressed like a deep-sea diver, nozzle in hand, circles the casting and cleans it inside and out with streams of sand.

Small castings are placed in slowly revolving machines where they are thoroughly cleaned by another type of sand blast which automatically directs jets of the abrasive against them from carefully adjusted nozzles. Before the castings go to the machine shop they are given a compressed-air cleaning, an operation that is in evidence throughout the factory. If the casting be a cylinder block, it is filled with water and tested for leaks under air pressure.

In the machine shop all heavy castings are put on the milling machines, lathes, broaches, drill presses, etc., by air hoists. Indeed, whole batteries of these hoists extend down the factory aisles wherever heavy machining is done and move the castings from one machine to the next until they are finally de-





the sand blast room for cleaning by means of air-propelled abrasive. Above is a glimpse of one of the machine shops, where hoists move the heavy pieces from machine to machine. At each stop, one or more requisite operations are performed on them. When the various finished parts are brought together on the assembly line, more air hoists come into play. There, also, various air-operated wrenches save time and make certain that nuts are tightened sufficiently. Finally, in the storage room where a supply of parts is maintained, air-operated hoists move heavy pieces to the desired positions and arrange them in piles (right).

livered to the cleaning booth at the end of the line. There, both air and steam are generally used to give them the final cleansing before they go to the assembly line, where pneumatic equipment is again in evidence. In this section, too, are many Ingersoll-Rand hoists. On the first subassembly line, where frames for the large models are made, we find air-driven rivet squeezers, and a little farther along air wrenches are used to tighten nuts on such important parts as sprockets and final drive housings. On the left we see pneumatic chucks in operation, and across the aisle are more air wrenches making short work of tightening the scores of packing nuts that hold radiator tubes in place.

From the assembly line the tractors go to the test room, where they are given a thorough running-in test before they are taken to the paint shop. There they are first cleaned with compressed air and live steam and then spray painted in specially lighted and heated booths.

Ready for shipment, and resplendent in its gleaming finish of yellow and black, the finished tractor is driven to the shipping room and right into a box car or onto a platform that will form the bottom of an export shipping case. As it rests there, ready to leave the factory to begin a life of useful work, compressed air performs a last service. Aboard the car comes the loading crew carrying heavy wedge-shaped blocks of wood and a pail of big spikes. One of the men has a small tool connected to a hose. His companion wedges a block beneath the track and holds a spike

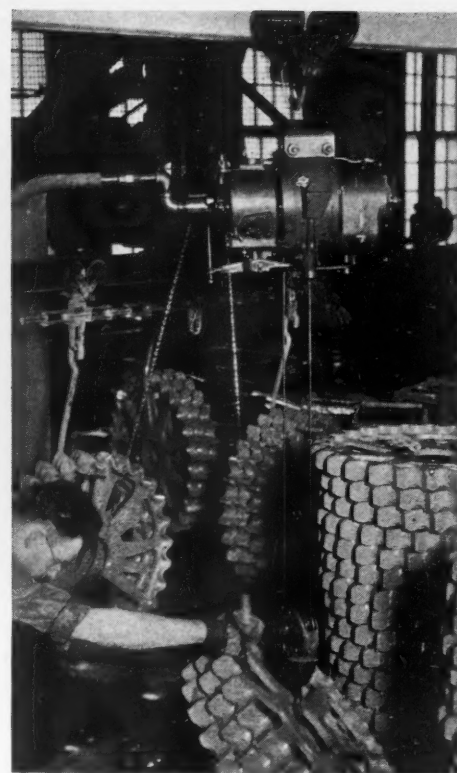
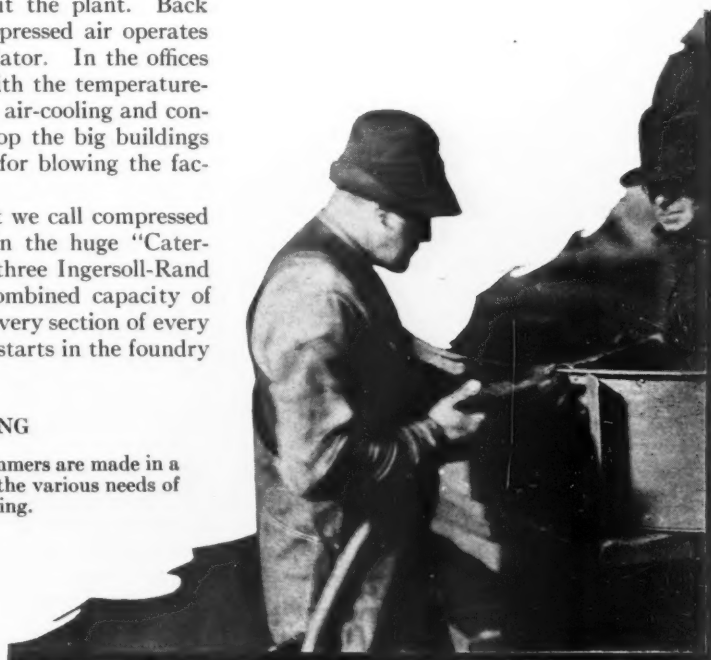
in place. Down comes the tool on the head of the spike. The operator pulls a trigger. There is a staccato chatter and a rush of air. The spike vanishes into the block of wood. An air hammer has given the finishing touch to the loading of a "Caterpillar" tractor.

But we have not seen all that compressed air does in building these machines. In one of the heat-treating buildings is a long bank of carburizing furnaces that depends on compressed air to atomize the oil that produces the intense, sustained heat so necessary in case-hardening. Alongside many of the electric rotary heat-treating furnaces stand automatic machines that control the quench given to heat-treated parts. Compressed air operates these machines and insures uniform results by timing the quench to a fraction of a second. In the combine and road-machinery factory are compressed-air burring and reaming machines. Close by, air clamps are holding parts together while they are being drilled and bolted; and such pneumatic tools as grinders, chippers and rivet squeezers are extensively used throughout the plant. Back in the power house, compressed air operates an automatic boiler regulator. In the offices it serves in connection with the temperature-control mechanism of the air-cooling and conditioning system; and atop the big buildings it has supplanted steam for blowing the factory whistles.

So this modern servant we call compressed air reaches everywhere in the huge "Caterpillar" factories. From three Ingersoll-Rand compressors, having a combined capacity of 2,000 cfm., it is piped to every section of every building. Its usefulness starts in the foundry

#### RIVETING

Air-operated riveting hammers are made in a wide range of sizes to fit the various needs of industrial metal fabricating.



and the machine shop and does not end until the last block is spiked beneath the finished machine. It enters not only into the building of every tractor but into the lives and comforts of the people who do the building. It calls them to work in the morning and sends them home at night. It adds to the well-being and efficiency of the office force and lightens the labors of those in the factory. By doing all these things it plays an important part in the manufacture of tractors, combines, and road machinery that are known for long life and quality construction wherever roads are built, crops are raised, or the wheels of industry turn.

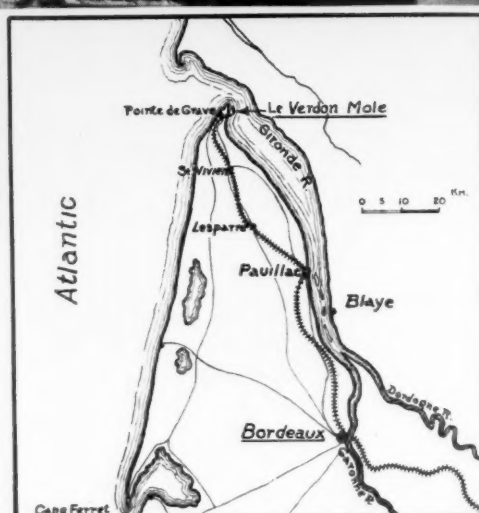


Photo from French Line

## Bordeaux Reaches Seaward

New Steamship Terminal 60 Miles from City  
Supported on Concrete Piers Sunk with  
the Aid of Compressed Air Emulseurs

R. G. SKERRETT



OPENING THE NEW PIER

Bedecked with gay flags, the terminal was formally opened for service on July 22, 1933. Above, a train is shown coming from the dock. To the right of the tracks is the driveway for motor vehicles. The upper portion of the Steamship Champlain of the French Line can be seen at the far side of the pier in the circle. The map shows the water area controlled by the Autonomous Port Authority of Bordeaux and illustrates how the city has reached down the Garonne and Gironde Rivers some 60 miles to establish facilities for large ships by constructing Le Verdon Mole. That advanced port is linked with Bordeaux by railroad. Electrification of the line, now underway, will reduce the travel time to about one hour. In point of cargo tonnages handled, Bordeaux was France's fourth largest port in 1932. Principal exports to the United States are cigarette paper, walnuts, mushrooms, talc, china-ware. In normal years, the walnuts alone are valued at \$2,000,000.

served to cut down the river journey about one-half and to lessen the delays occasioned by fog or other weather conditions causing low visibility. The savings in time thus made possible, together with the added convenience

**B**ORDEAUX points with pride to her historic background but she is equally mindful of the spirit of progressiveness that is manifested now by her people. Bordeaux has been of importance in Europe ever since the days of the ancient Gauls; but her present outstanding claim to attention is that she ranks high among the seaports of France.

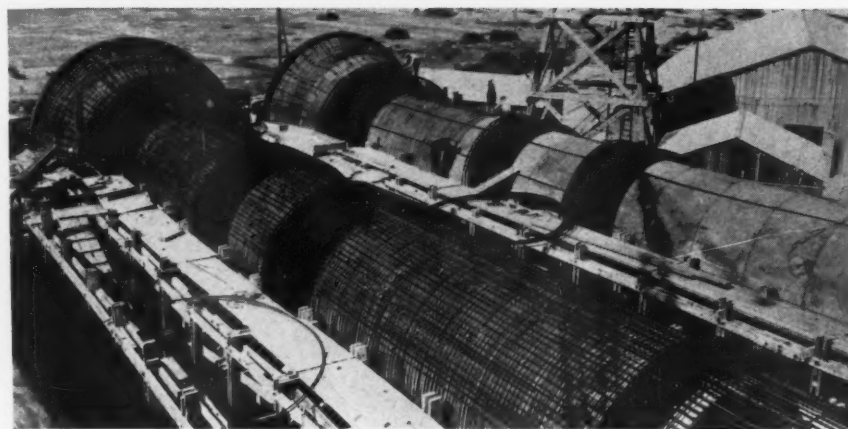
Bordeaux is situated on the Garonne River approximately 62 miles inland from the sea. The Garonne discharges into the broad sweep of the Gironde, and the latter splendid waterway empties into the Atlantic at a point north of the notoriously tempestuous Bay of Biscay. Bordeaux, aside from her own productiveness, draws upon a great and fruitful section of France and, on her part, distributes to that region vast quantities of imported raw products and finished commodities. Because of her favorable location, something like 6,000 ships, representing close to 9,000,000 registered tons, enter and leave that city annually. A very considerable share of this traffic is

between Bordeaux and the ports of both North and South America; and the biggest and finest of passenger liners are engaged in that service. This maritime business has been increasing steadily for years.

While barges and kindred shipping can travel on the Garonne above Bordeaux, larger vessels cannot do so because of the famous stone-and-brick bridge which spans the stream and which has linked Bordeaux with the opposite bank since 1821. Therefore the port's deep-sea trade has been taken care of by means of piers, basins, warehouses, and freight-handling facilities located successively farther and farther downstream, and especially where deeper water is available for docking big and speedy passenger liners that run upon prescribed schedules necessitating the comparatively rapid turn-round of the ships.

One typically modern base of this sort was created at Pauillac on the west or left bank of the Gironde and 31 miles below Bordeaux—the two cities being connected by rail. This

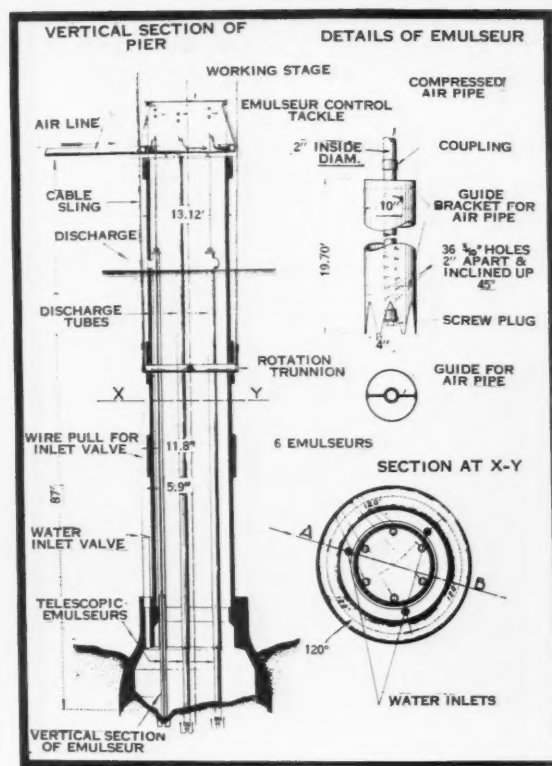




#### WORKING BASE ON LAND, AND EMULSEUR

The reinforced concrete pier cylinders were cast on land and seasoned before being launched and towed to their positions. Each pier is 87 feet long, 13.12 feet in outside diameter, and weighed 290 tons as cast. The weight when filled with concrete was 1,000 tons. There are 96 of these supports in the mole structure. At the upper left are

seven cylinders in various stages of production. Pictured below them is a close view of the assembly. After the inner shell was poured, section by section, the reinforcement was placed and the outer layer of concrete poured. The total wall thickness was about 6 inches. The system of excavation for these piers is shown at the right.



to passengers, have emphasized the desirability of linking Bordeaux by rail with some still more advanced landing place for ocean-going ships. The authorities of the Port of Bordeaux have provided an answer at Le Verdon, just inside Pointe de Grave at the very mouth of the Gironde River, where there has been recently completed a mole long enough to accommodate several large steamers simultaneously—a railway running between it and Bordeaux. This advance base was formally opened for service on July 22, 1933.

Simple as the foregoing solution of the problem may sound, nevertheless its accomplishment has called for engineering resourcefulness of a high order and the mastering of physical difficulties that would normally be classed as staggering. Even though the Gironde ebbs and flows into an estuary and not directly into the broad Atlantic, still when stormy winds blow from the north and east heavy seas sweep in upon Pointe de Grave and over the area of deep water chosen for the site of the mole. Manifestly, the mole had to be strong enough to resist at times the battering surge of waves and also so rigid that it could withstand the thrust of big steamships when landing. Not only did the exposed position make consummation problematical, but the nature of the water bed further complicated the project. Happily, the technical experts of the Autonomous Port Authority of Bordeaux proved themselves equal to every contingency of the great task. To appreciate what has been done it is essential that one have some understanding of the

hydrographic conditions that had to be taken into consideration.

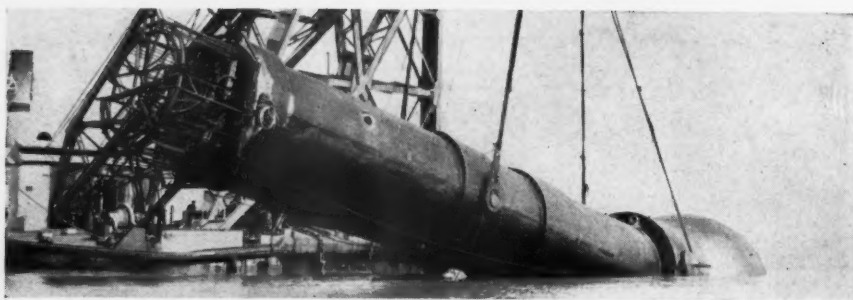
Le Verdon was considered as a place for an advance port quite 23 years ago, and authority to proceed was given in the early part of 1914. But the outbreak of the World War halted action. When fiscal conditions warranted it in 1928—following the creation of the Autonomous Port Authority of Bordeaux in 1925—actual work was begun. This work, however, was preceded by considerable experimenting because certain of the engineering features were without precedent, and their suitability had to be determined to a convincing degree before the final plans could be prepared.

The water bed of the estuary adjacent to Le Verdon is made up first of a stratum of beach sand from 23 to about 33 feet in thickness and containing interspersed pockets holding siliceous pebbles and shattered sea shells. Beneath it is a compact stratum of gray clay from 16 to 20 feet thick and capable of sustaining heavy loads indefinitely where not exposed to scouring action. The blanket of sand serves as a protection against this action. The depth of the water above the top of the sand stratum is from  $39\frac{1}{2}$  to  $52\frac{1}{2}$  feet, which necessitated piles or piers for the jetty more than 75 feet long so that they might find a satisfactory footing in the clay and project besides about 10 feet above high-water level.

After careful consideration of the situation, the experts were agreed that piers could not be constructed by driving series of closely

spaced reinforced-concrete piles because many in each group most likely would be damaged in driving. It was equally evident that it would be impracticable on account of the exposed position of the site to dredge a deep trench in the sandy stratum and to fill the excavation with great blocks of concrete to form a stable foundation for the mole. Furthermore, pneumatic caissons, such as are widely employed in setting bridge piers on rock in sheltered waters, could not be used in the Gironde—sudden storms being likely to halt operations at critical stages and sure to endanger the lives of the men in the working chambers. A solution of the problem lay in devising means and methods that would make it possible to place each pier with unusual speed and to reduce the offshore work to a minimum. As it has turned out, the jetty is supported by 96 piers arranged in parallel lines—three lines beneath the steamship dock and two beneath the section that connects the dock with the shore.

The form of the piers, their method of construction, and the means of sinking them at prescribed positions were conceived by M. Caquot—then chief engineer of bridges and highways—but developed for service, after a series of tests, by F. Leveque, chief engineer and director of the port authority, with the assistance of his staff. Some modifications in the model and the associate apparatus of the piers were made from time to time as the work progressed, as experience indicated where such changes could be made to advantage.



#### OFFSHORE OPERATIONS

Supported by a massive 300-ton derrick (upper right), each concrete pier cylinder was transported from the point of launching to its assigned position in the mole and there righted for sinking. It was sunk by excavating the material beneath it by means of modified air lifts, termed *émulseurs*, of which there were six in each shell. At the left is a pier being thus lowered, the escaping stream of water

being from one of its *émulseurs*. After it had been lowered through the sandy river bed to a firm footing on the underlying clay stratum, it was sealed at the bottom and filled with concrete. The third picture shows a pier about to receive its reinforced concrete cap for support of the deck structure. After the work became organized, piers were regularly sunk into position within seven hours.

As proposed by Mr. Caquot, each pier was to consist of a reinforced-concrete cylinder 13.12 feet in general external diameter, 70.5 feet long, and terminating at its lower end in a bell-shaped chamber having a sharp cutting edge designed to penetrate the sand and clay. Certain of the piers for the shoreward section of the jetty were of this design; but those sunk subsequently were somewhat different in form. Each was made 87 feet long; had a sturdier bell-shaped chamber; and weighed, when ready for placing, substantially 290 tons. Arranged symmetrically within each base chamber were six pneumatic excavators, known on the job as *émulseurs*—ingenious adaptations of the widely used air lift. Before telling how these operated, we shall describe the way in which the pier cylinders were first constructed on the beach close to the inshore end of the mole.

The cylinders were poured horizontally in sections and in forms resting on the ground, where they were left for a suitable period to season. As each cylinder was required for emplacing it was run on a low-wheeled carriage, traveling on a broad-gauge railway, to the water's edge, where it was launched on a slipway. There the cylinder was picked up by a floating derrick of 300 tons dead-load capacity. Partly immersed and caught at two points so as to hold it horizontal, the cylinder was carried to the site where it was to be sunk. Arriving there it was swung into an upright position by means of a transverse trunnion or heavy steel bar housed in a sleeve with its two ends projecting from opposite

sides of the cylinder well above the center of gravity. Two great hooks, suspended from the derrick, engaged the trunnion and thereafter continued to maintain the pier in a vertical position until the cutting edge had reached its seat about 2 feet deep in the firm and stable clay. The use of the derrick for this purpose was found necessary inasmuch as the pier could not be kept entirely upright during sinking by controlling the excavating action of the *émulseurs*. On an average, two hours elapsed between the launching of a cylinder and the planting of its cutting edge on the sandy bottom of the estuary. Then about seven hours more were required to get the pier down to its resting place in the clay. This procedure obviated the actual construction of each pier at its permanent site and thereby greatly shortened the time of placing and minimized interference by oncoming stormy weather.

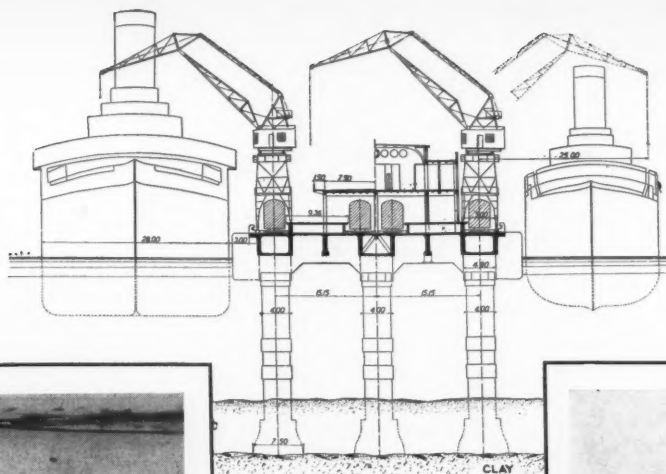
Each excavator consisted essentially of an enveloping tubular casing about 10 inches in internal diameter and long enough to reach from a point a foot or more below the cutting edge to the top of the pier cylinder. The lower end of the casing was cut so as to form a series of tapered teeth that would serve to promote penetration of the water bed as the *émulseurs* worked their way downward. Compressed air was conveyed to the bottom of each excavator by a pipe, having an inside diameter of a little less than 2 inches, held by brackets in the center of the tubular casing. The air pipe was plugged at the bottom end, which was pierced by 36 outlets about

3/10 inch in diameter—the holes being inclined upward at 45 degrees and spaced approximately 2 inches apart vertically. The purpose of this arrangement was to stimulate the ascent of the emulsified material by sending the impulse air in that direction. Two 950-cfm. compressors aboard the floating derrick furnished air for this service.

The descent of an *émulseur* was regulated through tackle by men on the working platform at the top of the pier cylinder, and each was lowered as the cylinder penetrated the water bed and to a degree that would assure fairly uniform subsidence of the latter. In this manner it was found practicable to maintain the sinking of a pier within 10 degrees of the perpendicular—further correction being obtained by varying the load on the two derrick hooks.

It was essential that the dead weight of the cylinder should for the most part bear continually upon the material being penetrated lest the rate of excavating exceed that of settlement—in effect, increase the external hydrostatic pressure and thus induce a sudden and violent inward flow of the outlying bottom material. Similarly, too rapid an excavating action on the part of the *émulseurs*—that is, lowering the water level within the cylinder beyond a given point, was apt to cause hydrostatic unbalance that would provoke a "blow" or inflow of the enveloping water bed. To obviate this, small tubes, cast perpendicularly in the collar of the base chamber and connecting the latter with the water outside, were made to serve as pressure





#### CONSTRUCTION VIEWS, AND SECTION THROUGH DOCK

At the left is a view looking landward from a position on the foundation structure, showing the wide dock section and, beyond it, the curving approach section that connects with the shore. The over-all length is more than 2,000 feet. The right-hand picture shows a

portion of the shoreward section. The elevated structure is part of a ramp that carries the roadway for motor vehicles bound to or from the passenger terminal on the mole. The drawing is a section through the dock. Dimensions are in meters.

equalizers. At the upper and exterior end of each of these tubes was a flap-valve that could be lifted by pulling wires leading up to the working platform. Water was thus admitted at intervals to the interior of the cylinder to compensate for the solid material removed by the *émulseurs*.

At points where the latter effected passages through pockets of broken shells and so-called pebbles, some of the stones swept to the surface by the air lifts were as big as a man's fist.

As soon as the cutting edge of the cylinder had passed through the sand and penetrated the clay a few inches, the latter material formed an effective seal against the admission of external water. When this seal was obtained, and all the sand in the lower chamber had been excavated, then the *émulseurs*, acting as clear-water pumps, were deliberately used to unbalance the hydrostatic head by considerably lowering the level of the water within the cylinder. The effect of this procedure was to increase the dead weight of the pier, to force the cutting edge deeper and deeper into the clay until the prescribed anchorage was reached. Without resorting to this easily controlled operation, the cutting edge could have been made to penetrate the clay only by loading the working platform with tons of material that would have had to be removed subsequently. When the pier was properly seated in the clay, concrete was poured into the still flooded bottom chamber through a removable chute; and enough of it was placed to fill and effectually to plug the

base of the pier.

After the concrete in the bottom chamber had set, the remainder of the pile was pumped dry and filled with concrete up to the top, making the pier a huge monolith with an enveloping reinforced shell and having an average thickness of about 6 inches throughout the long main body.

Then a concrete cap was secured to the top of the pier. The form of this cap is such that it affords bearings for the lengthwise and the crosswise structural units constituting the supports for the deck of the approach viaduct as well as for the lower deck of the steamship landing at the outer end of the mole.

Passengers board and leave the liners by an upper deck from which they can descend to the trains standing on the deck below, or they may leave the upper level by motor vehicles—a ramp for this purpose leading to the roadway at one side of the approach viaduct. The steamship pier is 125 feet wide and 1,041 feet long, and has a tapered section, 200 feet long, that joins with the curved approach viaduct which is 1,023 feet long and 50½ feet wide. On the latter structure are two tracks, and on the outer section of the mole are four tracks—two in the center and one along each side. This arrangement makes it possible to operate both passenger and express trains without interfering with one another. The mole is equipped with derricks for loading and unloading shipments, supplies, and baggage expeditiously; and in all other respects this advance terminal is strictly up to date. At low tide the depth of the water on one

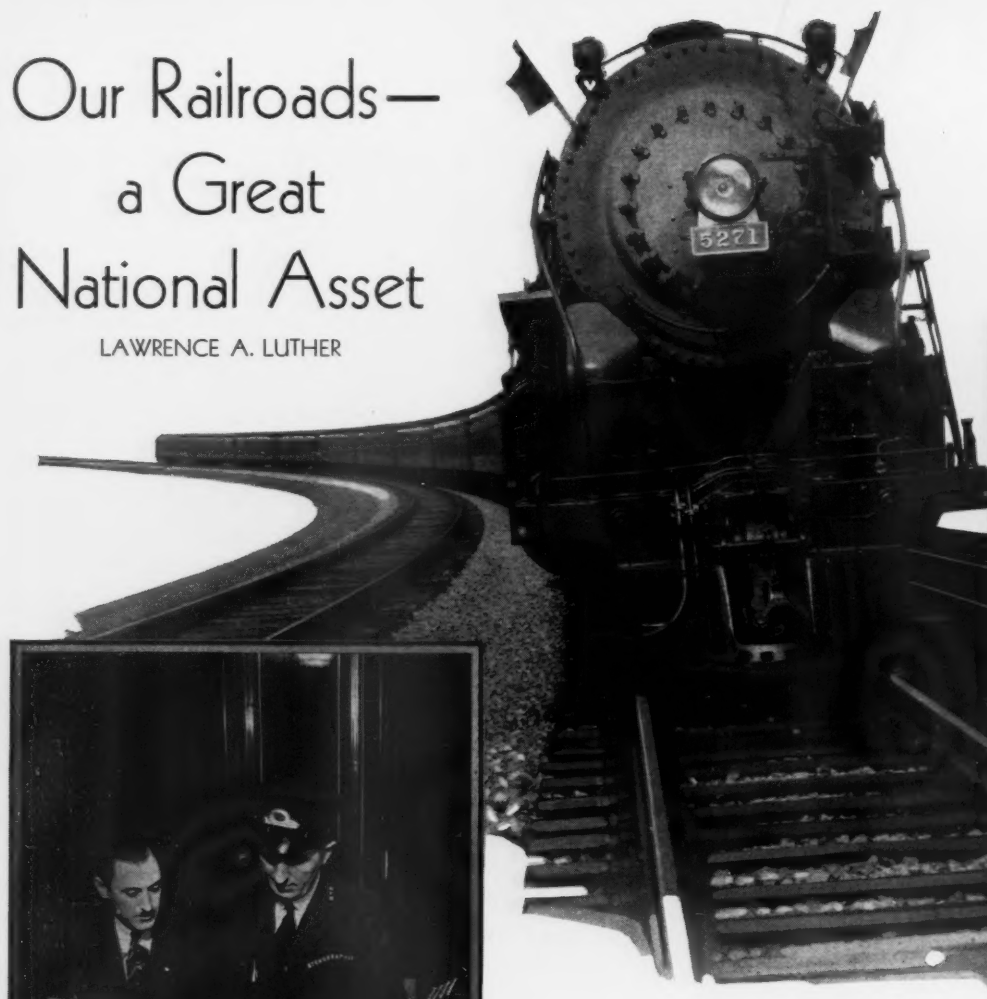
side of the steamship landing is 39½ feet and on the other side 46 feet—ample for the largest of ocean liners.

It may interest the reader to know that the marine equipment employed in this work consisted of four floating derricks—the 300-ton unit already mentioned, one of 120 tons, and two of 40 and 30 tons, respectively—and of four seagoing tugs each of 500 hp. On shore there were twelve electric and steam cranes of various capacities. Ten diesel tractors were used to transport materials; as many as ten concrete mixing machines were on the job; and electric energy for various services was produced by a 400-kw. generator driven by a diesel engine. In addition to the compressors on the floating derrick there was a shore plant of five units, each discharging about 300 cfm. The actual building of the mole was in the hands of the Société Anonyme Hersent, with the financial support of the well-known firm of Julius Berger, Berlin. The execution of the contract was under the direction of Mr. Levêque, to whom the author is indebted for most of the information and illustrations used in this article. The resident engineer was M. Peltier.

According to the estimates, the entire undertaking will cost about 195,000,000 francs—nearly \$11,000,000 at the current rate of exchange. Large as this sum appears, the accruing benefits will amply recompense the people of Bordeaux by making that enterprising port better able to maintain its position in the forefront of foreign trade that reaches to all parts of the world.

# Our Railroads— a Great National Asset

LAWRENCE A. LUTHER



## ALL'S WELL ABOARD THE FLYER

A few years ago it was considered prudent to buy accident insurance before starting a long rail trip. Today home life presents more hazards than railroad traveling. With modern equipment and safety appliances and a highly trained crew safeguarding them, passengers ride in virtually complete security from danger. Private bedrooms, with real beds and other comforts of home, contribute to restfulness. The business man need not cease work, for the train stenographer is ready to lend secretarial aid.

**W**EARLY cavemen, Eskimos traveling iglooward through the arctic night, commuters swinging on the straps of New York subways, all use various grunts, gutturals, or words to say essentially the same thing: "There's no place like home."

Yet we are assured on unquestionable authority that, in spite of recent aids to domestic comfort and security, the best of homes lie close to the frontier so far as our personal safety is concerned. Monsters, they aver, lie constantly in wait for us at home, and actually caught and killed 24,000 persons in the United States last year. These monsters include not only fire, stepladders, and rampant rolling pins, but such trusted servants as bathtubs and oak floors. Statistics do not, in fact, greatly encourage us to endure these myriad hazards of the hearth if any proper pretext can be discovered for going abroad. The nicely correlated figures bring into sharp relief the comparative security that we enjoy while traveling on American railways, for it appears that when we step aboard a train we reduce home-haunting dangers almost to the vanish-

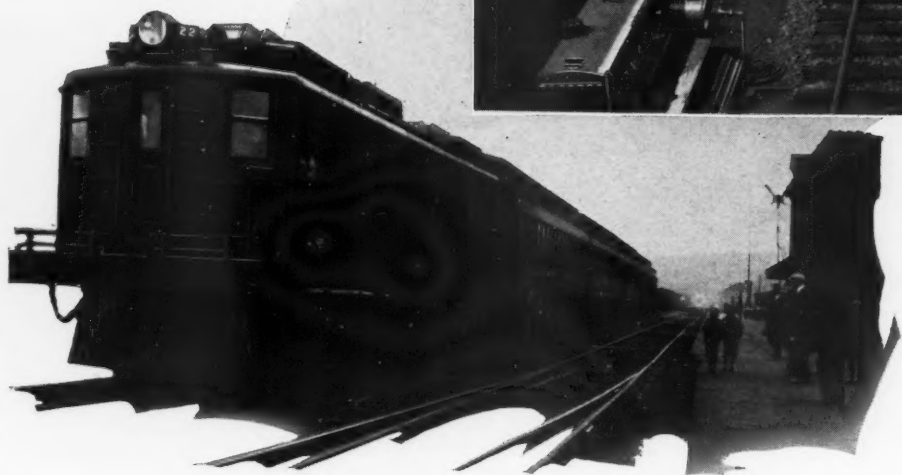
ing point. This fine showing, however, has not been attained easily, and is in striking contrast to the early days, a century ago, when a short journey by rail was only less hazardous and exciting than fighting with the Indians who then still abounded.

A first-rate example of these early adventures via rail is found in an account of the first steam-drawn passenger train that was run over part of the route which has since become a main line of the vast New York Central system. John Jacob Astor, Stephen Rensselaer, and other notables spent many years in financing and building some fourteen miles of line between Albany and Schenectady; and one of the essentials most difficult to procure was a locomotive that would not only emit quantities of smoke and steam but run steadily for several miles and draw a few stagecoaches mounted on flanged wheels.

There 11½-foot-long *DeWitt Clinton*, built at the West Point Foundry, held the center of the stage on an August morning of 1831, and the venturesome who had purchased tickets had a large and enthusiastic gallery

not only at both terminals but all along the line. Carriages and harness suffered much damage from horses whose first glimpse of their new competitor sent them off in headlong flight. For the *Clinton* responded splendidly to her throttle—in fact, fairly leaped away from the starting line, and the cars, being coupled loosely with 3 feet of chain, were set in motion by a series of smart jerks. High beaver hats and poke bonnets were crushed, and some bruises resulted. Stopping proved even more cataclysmic than starting, for when the engine brake was set each car was catapulted violently against the next ahead. Passengers thereupon instituted the first practical railroad safety program by hewing suitable spacers out of fence rails and tying them in place between cars. As the little engine was built somewhat upon the direct-draft principle, and as pitch pine served as fuel, the stack cast out considerable quantities of burning brands and clouds of dense and pungent smoke. Though the occupants of the coaches enjoyed a measure of protection, the demand for seats had been so pressing





#### SMOOTHING THE WAY

Infinite care is expended in constructing and maintaining road-beds. Above is a 12-tool tie-tamper gang at work placing ballast under ties. Compressed air for this important service is supplied by the rail-car compressor in the lower left-hand corner of the picture.

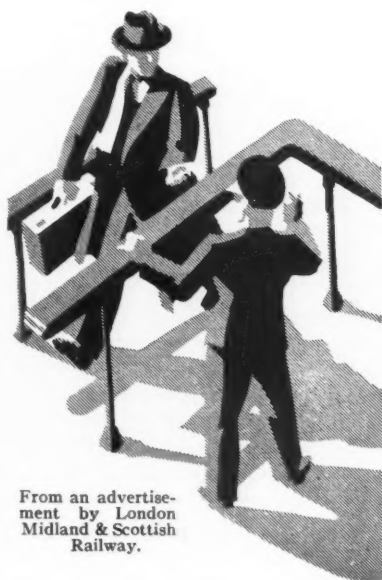
Operating economy, freedom from smoke and cinders, and almost 100 per cent availability for service are some of the advantages offered by the oil-electric locomotive. At the left is one of these new-type engines drawing an Erie train during a test run.

that several flat cars had been added. The unfortunates on those "observation platforms" were forced to fend off the sparks with parasols until they were consumed, and then to fall to like good samaritans and beat one another's garments as they were set afire. No record exists of any loss or damage claims; our forebears, having actually participated in the creation of a new industry, perhaps deemed a hat or a few yards of homespun a trivial contribution.

If you are a traveler and have chosen to ride on the Twentieth Century or other "limited," you will hardly, unless you are statistically minded, relax with the thought in mind that you are assured the ultimate in personal safety as you go bowling along at something over a mile a minute. The 80-ton steel coach you ride in is not constructed at the lowest possible expenditure that will provide essential space and comfort. It is a species of huge projectile built so as to offer you reasonable protection against harm from any disaster short of plunging over Niagara Falls or the walls of the Grand Canyon. Its massive beams and plates and twelve steel wheels are eloquent evidence that our railroads recognize the fact that human safety is the first consideration of any transportation code; and when a railway official tells you that our roads carried 480,000,000 passengers in 1932 without one fatality as the result of a train accident, there is a light in his eyes that reflects his pride. Keeping you safe through sunshine or blizzard

while you ride on American rails is a large order, but more than a million men and women are engaged at that task; and in the case of groups charged with operation and maintenance, the training is of a military severity.

If you take your way westward along the shore of the historic Hudson on a summer afternoon, you may, in crossing the rolling farms and woodlands of "York State", lose yourself in a reverie about the scenic wealth of our continent, or picture the huge Conestoga



From an advertisement by London Midland & Scottish Railway.

wagons which blazed this transportation trail for the locomotive. But the smooth and silent operation of your train and its homelike facilities for working and resting and for eating and sleeping are almost as much a matter of course as the sunset on a bright day. Courtesy amounting to graciousness is expected and received from the personnel on all crack trains; and many of the latter provide facilities for baths, barber and valet service, and someone to take a letter.

But it is not always summer in western New York; and winter is sometimes severe. Arctic storms, after raging down across Canada, seem to find in the Great Lakes country a favorite terminus at which to stage final demonstrations. The lakes become as tempestuous as the North Atlantic, and blinding snowstorms threaten every line of communication. If you will ride for a few minutes in the cab of one of the great Hudson-type engines on a night when the whole earth seems swathed in a blanket of whirling snow, you may feel again your boyhood worship of the mystery and power of a speeding locomotive. The *mahout* in overalls who manages the great beast seems hopelessly inadequate to defy, along what appears to you a pathless way, the combined hazards of darkness and storm. But he is one of the knights of the throttle: his selection from among hundreds of his fellow workers is indicative of intelligence, poise, and skill. He belongs to a high caste and is one of the most contented of men,



### GROOMING THE IRON HORSE

Steam locomotives receive attention that amounts almost to tenderness. After each run they are gone over carefully and made ready for succeeding service. Above is shown a Lehigh Valley Railroad engine being washed with oil and water sprayed by compressed air.

Railroads that touch waterways maintain extensive marine departments to handle passengers and freight. At the right is one of the new Erie tugboats in New York Harbor. They are powered by two 600-hp. oil engines.



for life, in gratifying his chief ambition—to pull a great limited—has brought him unusual compensations. Blindfold him, and yet he will tell off every switch and curve, even locate approximately every signal and milepost. Backward and forward he has made his run hundreds of times by sunlight and moonlight and no light at all until he has got the sound and feel and peculiar cadences of it. His company has invested \$5,000,000 in train control, and his line is equipped with a system that makes emergency brake applications should engineers fail to stop on "red boards," indications of occupied blocks. But to permit the electric relays to assume his prerogative of handling the brake valve would be a lapse never quite to be lived down. It is not the disciplinary or financial penalty of such an error that looms largest, but the betraying of a trust imposed upon him.

A safe, swift pathway through the storm is not maintained without a great expenditure in brain and brawn and tireless vigilance. While your engine driver has been assigned the most dramatic rôle, you have a thousand other men in alert attendance. Snowplows and flangers shuttle continually back and forth; and their crews, along with laborers and superintendents and operators in signal towers, feel a warm glow of satisfaction as the limited roars past. They are minutemen in the great army of transportation. Each has a proprietary interest in the fine trains running over his line, sensing their significance as

valuable social and economic factors in our national life.

If you pursue business or pleasure, or heed the more imperative demands of illness or death, they are the men who will keep your railway route open even though every other pathway be closed. If you take your way westward from Chicago over the Santa Fe Trail, the old Overland Trail, or a trail penetrating the Far North and whose very existence is a constant challenge to King Winter, you will find a regiment of experts waiting to serve you—men who have gained their experience through long apprenticeships in those particular territories. They are imbued with the idea that, speeding in foul weather as well as in fair, their trains must carry you and your goods with dependable swiftness. For instance it costs the Southern Pacific Company as much as \$121,000 a year to fight snow on 85 miles of track crossing the High Sierra; but the mail goes through on schedule while thousands of stranded motorists and their cars are ferried annually from Reno to their mecca in the land of sunshine. A winter crossing of this high pass—with an intimate view of Donner Lake—reminds you a large party of emigrants perished in the Sierra snows before the existence of the railroad, that it was not always an all-weather road.

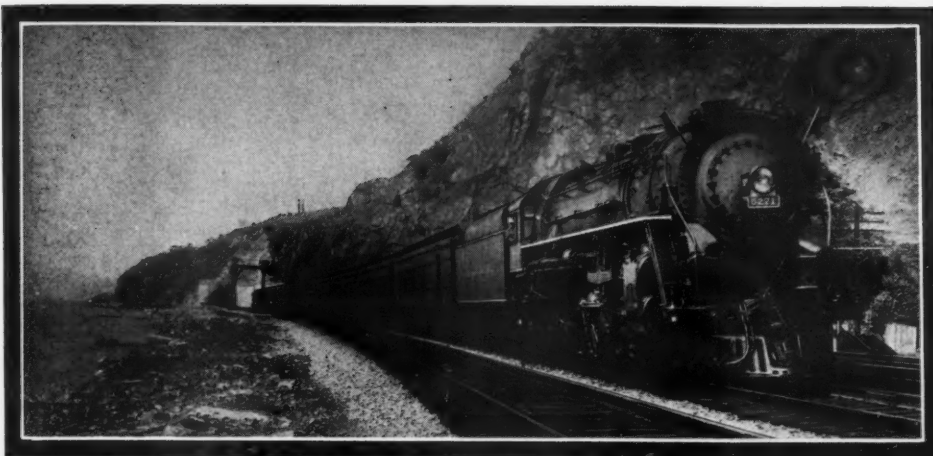
The water-level route of the Twentieth Century is a typical example of what constitutes an all-weather road. The track structure must be stable and smooth for speeds as high

as 70 miles an hour. Heavy rails are secured by closely spaced ties and especially rigid joint bars. The uniform bearing of ties in an expensively deep ballast bed—a matter much discussed at the American Railway Engineering Association convention of 1933—long has been a cardinal feature in New York Central construction. Pneumatic tie tampers are universally employed both in general resurfacing and in routine maintenance to achieve this result.

In this unremitting effort to keep their steel speedways as strong and as safe as science and labor can make them, our railways have not been content with the intensive inspection of rail steel as it emerges from the furnaces in blooms and ingots to be rolled into precise sections, nor with analyses of its chemical content, nor yet with a record of the heat numbers and a careful charting of the rails' behavior in service. Nearly all Class 1 roads now employ Sperry detector cars which locate and plainly mark for removal rails with incipient fissures and other structural defects that might become hazards. This wedding of science and safety is in tune with the spirit of the times which, in spite of a partial paralysis of business, has been imperative in its demand for speed.

Even through rugged Scottish highland, the time of the famous London-to-Edinburgh *Royal Scot* has been cut. France advertises the fact that she has 21 railway runs, totaling 2,373 miles, which the trains make at scheduled





#### ON THE ROAD AND BEHIND THE SCENES

At the top the Twentieth Century Limited of the New York Central Lines is shown bowling along the shore of the Hudson River nearing New York on its daily 960-mile run from Chicago. At the left is a scene in a club car on this crack train, where passengers lounge or read in comfortable chairs as the wheels click off the miles. Back of the "on time" records of

our leading railroad systems are modern, well-equipped shops where rolling stock is kept in condition for service. Compressed air is an indispensable agency in the construction and maintenance operations that are carried on there. The right-hand picture shows a large motor-driven air compressor in one of the shops of an Eastern railroad.

speeds higher than 60 miles an hour. The stream-lined, diesel-electric *Royal Hamburger* covers the 178 miles between Hamburg and Berlin in 130 minutes, an average speed of 76 miles per hour.

There has been a tendency on the part of certain writers and economists to create the impression that our railroads, like the stage-coaches of the early days, will become out-moded. They are, in fact, still young, and, given the opportunity, will continue to grow in efficiency if not in number or in length. Voluminous data are in the files of nearly every major road covering projected improvements: grades and curvatures must be lessened, tunnels driven, distances shortened on hundreds of miles of line vital both to our economic welfare and to our national defense.

Railroads spend money if they earn it. Just now they represent the second largest pillar in the nation bearing up the burden of governmental costs, which we have discovered to be extremely heavy. With few federal, state, or local budgets balanced, and with every government taxing body looking searchingly at us to discover how it may assess us further to cover the deficits, we are bound to

hope that the railroads may somehow manage to carry on in their three-quarter-million-dollar-a-day tax-paying rôle.

Railway taxes form the major portion of the incomes of many of our so-called "sagebrush states" in the West. Abandonment of a branch line is invariably a local catastrophe, jeopardizing the very existence of such social essentials as school districts. Abandonment in more populous sections is no less vital, if somewhat less of a misfortune. The New York Central, one of the several lines entering New York City, paid that municipality in taxes in 1931 the sum of \$9,881,773. It is the largest taxpayer among the nation's railroads.

The railroads appeal to us directly through the medium of our pocketbooks because they give us our money's worth. Yet there are voluble theorists who advocate government ownership as the one sure solution for every railroad dilemma. There are few of us who do not hold an equity in one or more lines either directly in stocks and bonds or through investments in insurance or deposits in banks, and the more thoughtful will be chary of bartering away the well-worn principles of Yankee individualism for plausible quasi-

collectivism.

Railroads enlist our loyalty as advocates of human welfare. Nearly all major lines have pension systems through which many millions are disbursed annually; all offer the best of medical and hospital care to employees either gratis or at nominal expense. Adherence to the principle of seniority, even throughout the days of the depression, has evidenced a determination on the part of railway managements to recognize and to reward long and faithful service. They are among the comparatively few employers that have accepted so definite a responsibility for employees or built so solid a foundation for the establishment of confidence and *esprit de corps* among personnels.

Whether we are charterers of trains who advertise vast stage productions, or shippers, seekers of safe transportation for our families, travelers to some distant burial place for relative or friend, invalids who must have every care and comfort, honeymooners, habitual stay-at-homes—no matter what may be our part in the pageant of human existence—our railroads are and will continue to be vital to us.



## Safeguarding Health by Sewage Disposal

C. H. VIVIAN

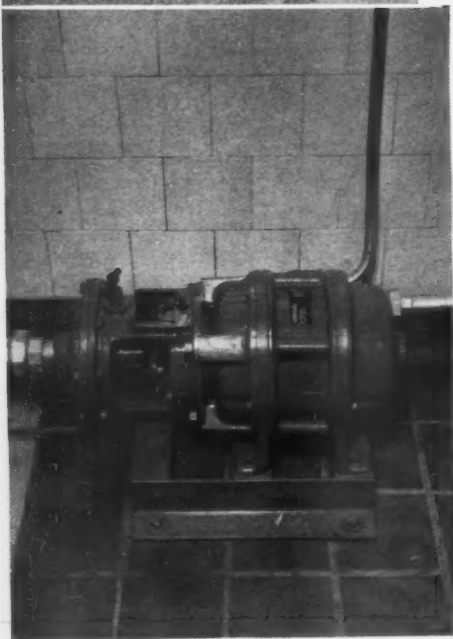
UNTIL the City of Hamburg, Germany, was swept by a devastating epidemic of Asiatic cholera in 1892-93, only doctors and a comparatively limited number of enlightened laymen accepted the theory that many diseases are transmitted by germs. Wholesale deaths—more than half of the 16,000 cases in Hamburg proper were fatal—brought about a careful investigation of the ways in which communicable diseases are spread. In the face of the preponderance of

evidence that developed, there could no longer be any doubt that in this case minute bacteria were the death-dealing agencies. It was fairly well established that these were disseminated throughout the city by the drinking water. The water supply came from the Elbe River, and the intake point for it was within the zone of tidal flow. The drainage of the city also ran into the river, and some of the sewage was thus being recirculated.

Much corroborative evidence of the germ theory also came to light. There was a general exodus from Hamburg, as all those who could leave fled lest they, too, contract the dreaded cholera. Many of these were already but unknowingly carriers of the germ, and they served to spread the epidemic into various parts of Europe. Berlin was surrounded by infected areas, and many cholera sufferers entered the city, but the disease never became epidemic there. Throughout most of England there was likewise freedom from general

### SEWAGE DISPOSAL AT DEAL

Deal's sewage disposal plant is underground, close to the shore. The figure in the central picture is standing at its entrance. The effluent is piped several hundred yards out to sea before being discharged. At the left is the Motorpump which recirculates a portion of the effluent during chlorination. Pump and motor are in one compact unit that can be installed quickly and easily and that operates without attention. Typical homes in Deal are illustrated at the top of the page.







## Three New Jersey Communities Reduce Water Bills by Recirculating Effluent

ravages. When these and other facts were sifted, and the reasons for them were studied, the striking truth stood out that wherever adequate facilities existed for public sanitation the cholera had been unable to get a foothold.

The lesson was a costly one; but it drove home in an unforgettable manner the imperative necessity of safeguarding public health by properly collecting and disposing of city waste materials. In the years that have followed, much progress has been made along this line. Today, as a nation, we recognize and understand the germ theory and have a wholesome respect for cleanliness. Protection of water supplies is one of the cardinal civic virtues. Sanitary engineers and doctors, aided by corps of inspectors, are ever on the alert to prevent pathogenic bacteria from reaching us.

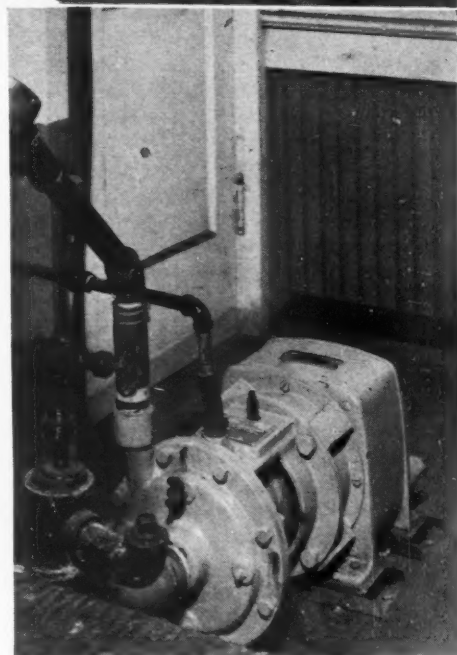
Manifestly, the proper care of sewage is of prime importance to public well-being. During the past 30 or 40 years it has become increasingly urgent because within that period larger and larger percentages of the population have become city dwellers. Between 1890

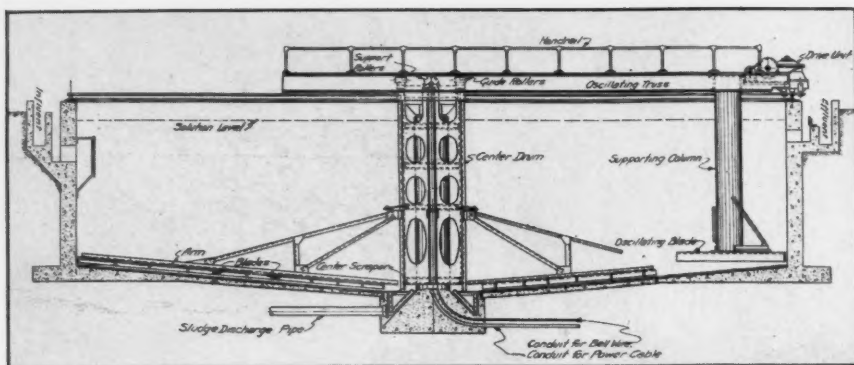
and 1920 our urban population rose from 25,000,000 to 64,000,000. The growth of our industries has also had a bearing upon the situation. A few decades ago only ordinary household wastes had to be considered. Nowadays, we must in addition take care of vast quantities of chemicals, oils, and various other contaminating substances that are disgorged from factories and industrial establishments.

Furthermore, it is desirable and essential that we safeguard not only ourselves but also our neighbors. States have taken cognizance

### OCEAN GROVE PLANT

In the center is the board walk where thousands promenade on sunny summer days. Within the building shown is installed the Motorpump pictured at the right. Savings in water which it effected were sufficient to pay for the unit within a few weeks. It ran 24 hours a day for five months in 1932 at a total maintenance and repair cost of less than \$1.50. At the top is the auditorium where the Ocean Grove Camp Meeting Association holds its religious services.





## MECHANICAL CLARIFICATION

In Long Branch, raw sewage is pumped into two concrete tanks (below), each 50 feet square and 14 feet deep. They are fitted with Dorr mechanical clarifiers, which consist of traveling arms whose revolving actions move the sludge to a central outlet through which it is periodically removed by pumping. The mechanism is suspended from a carriage which turns upon a pivot at the center of the tank. Its outer end travels about the periphery of the tank on a steel rail. The influent, or incoming sewage, enters the tank through a baffle at its right. The effluent flows over a weir at the opposite side. The cross-sectional sketch at the left explains the manner in which the clarifier works.

of this fact and have set up regulations which must be complied with. The growing popularity of beach bathing has placed added stress upon our obligations to others. We are morally, and in most cases legally, bound to keep the waterways fit for human aquatic activities. Another angle is the protection of fish and other forms of water life. Sewage pollution means death to them, either through diminution of the essential oxygen supply or through direct poisoning.

Much remains to be done in this country and elsewhere. We still have mild epidemics of typhoid fever and other water-borne diseases. There are numerous towns and cities where the handling of sewage is not all that is to be desired; but, by and large, we have gone far along the road of sanitation during the past half century. Without exception, communities are now awake to the seriousness of unrestricted sewage, and those that have not already taken steps to correct undesirable conditions are studying their individual problems with a view to doing so.

The theory and practice of sewage disposal has undergone many changes since the problem first came to the forefront of municipal study; but it can be said to be still in the process of evolution. The most common method of disposal, particularly in cities of small size, is merely to run the sewage into open streams or other waterways. This dilution method, as it is called, does not eliminate the danger, although it does serve to lessen it. The belief formerly prevailed that running or moving water would purify itself within a relatively short time, but this theory is now known to be false. Unfortunately, the dilution method is still practiced to a considerable extent, although the trend is towards more positive and safer means of disposal. Most outstanding among the communities that are turning away from this system is New York City, which has plans formulated for a multiple-plant disposal system which will entail an outlay of close to \$300,000,000.

The first accepted method of sewage disposal which was devised to prevent waterway pollution was that of running the waste material out upon vacant land. This was the recommended treatment in England and other European countries; and even today the so-called sewage farms of Paris, Berlin, Nottingham, and elsewhere are said to be successful. On the whole, however, this practice has been found to be unsatisfactory and unreasonably costly, and it has been largely supplanted by more scientific methods.



The rise of modern sewage-treatment systems is intimately related to the development of chemical and biological research. Various means are now available for handling sewage by which solid matter is removed and the liquid portion is rendered harmless, or so nearly so that it can be safely discharged into open waterways. Obviously, no single method is acceptable for all towns and cities. The determination of the most suitable one depends upon many factors, of which the size of the community to be served is perhaps the most important. It is not our intention to attempt a discussion of these several methods, but only to call attention to the practice of three towns along the eastern seaboard and to report upon a departure from established procedure that is proving economically significant.

The localities referred to are the seashore resorts of Ocean Grove, Deal, and Long Branch, N. J., where noteworthy savings are being made in the sewage-disposal plants by recirculating a portion of the effluent, or outflowing liquid, during the chlorination process instead of using water from the taps for that purpose. Their experience indicates that similar conservations of water can be realized in many cities and towns with resultant reductions in operating expenses which will

vary in each instance according to the amount of sewage handled and the rate that must be paid for water.

The three municipalities are in the same general neighborhood, being separate political subdivisions in a continuous inhabited belt that fringes the seaside and of which Asbury Park is the largest and best-known city. They are essentially summering places, and during the warm-weather seasons of the year their populations swell enormously. Over weekends and holidays the number of people they harbor may mount as much as 6,000 per cent above normal winter figures. Most of this influx comes from New York City, which is less than two hours' train ride away. All of them attract these hordes of humanity primarily because they are shore points. Their beaches are their biggest drawing cards, and probably nine out of every ten persons that visit them enter the water one or more times during their stay.

Because they are centers of bathing it is of especial importance that these communities adequately safeguard their adjoining stretches of ocean against contamination from sewage. Not only are the local authorities diligent about this, but the systems of handling sewage are also subject to the regulations of the New Jersey Department of Health, an



## TWO-STORY PUMPS

To safeguard against service stoppages in case of broken sewer lines or flooding from other causes, it is usual practice to place the motors that drive sewage plant pumps high enough that they can operate even though the pumps become submerged. At the right is the control room of the disposal plant at Long Branch. Shafts from the four vertical motors extend through the floor to the pumps pictured below. These pumps vary in capacities from 400 to 1,000 gpm., and any number of them can be used as required to move incoming sewage from wet wells to the clarification tanks. The upper view also shows the switchboard and the small standby generator set.



organization which is known for its efficient functioning.

The method of sewage disposal practiced in Ocean Grove, Deal, and Long Branch is that known as clarification by sedimentation. The raw sewage is led into shallow tanks, where its velocity is reduced sufficiently to bring about settlement of the solid portions or sludge, which is subsequently removed. In the case of Long Branch, the sludge receives the supplemental treatment of digestion. The remainder—consisting of liquid bearing in suspension the non-settleable matter, some of which is of a colloidal nature—is allowed to run off and is discharged into the ocean, several hundred yards from the shore, through an outfall line. During the seasons of the year when there is no beach bathing this is deemed to be adequate treatment, but the state health authorities ruled several years ago that additional means of safeguarding the effluent, or discharge, must be taken during the warm-weather period. Accordingly, during the five months between May 15 and October 15, chlorine is introduced into the sewage as a germicide.

It may be mentioned here that the rendering of sewage antiseptic with chlorine is practiced in some 400 or 500 towns and cities in the country. The prevailing method of applying

the chlorine is to inject it by means of a stream of water. The chlorine is fed continuously by machines which can be set to introduce it at the desired rate. This rate varies according to the amount and the character of the sewage, and is determined in any particular case by periodical tests. To be effective, chlorine must be in contact with the sewage for from 15 to 30 minutes, and it must be added in such amounts that there will be a slight excess or residual of chlorine after a 10-minute contact period. The exact manner in which chlorine exerts its destructive action upon organic matter is not fully understood; but experience has shown that, when it is properly administered, approximately 99 per cent of the bacteria originally present in the sewage are removed or rendered harmless.

Standard practices of chlorination are followed in the three plants under discussion. The chlorine is delivered in flasks, where it is held under such pressures as to render it liquid. When it is valved out of these flasks it assumes a gaseous form because of the reduced pressure. As the introduction of the chlorine is continuous, considerable water is required to carry it into the sewage. It has been the custom to use tap water for this purpose, and where such water is plentiful or inexpensive there is no great object in

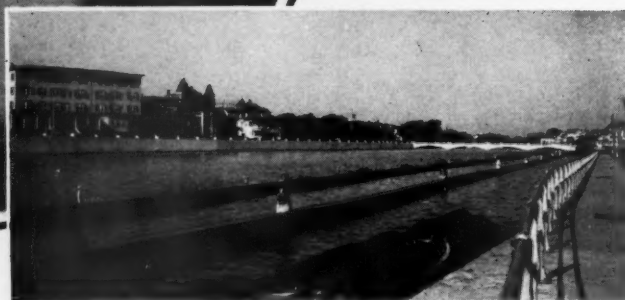
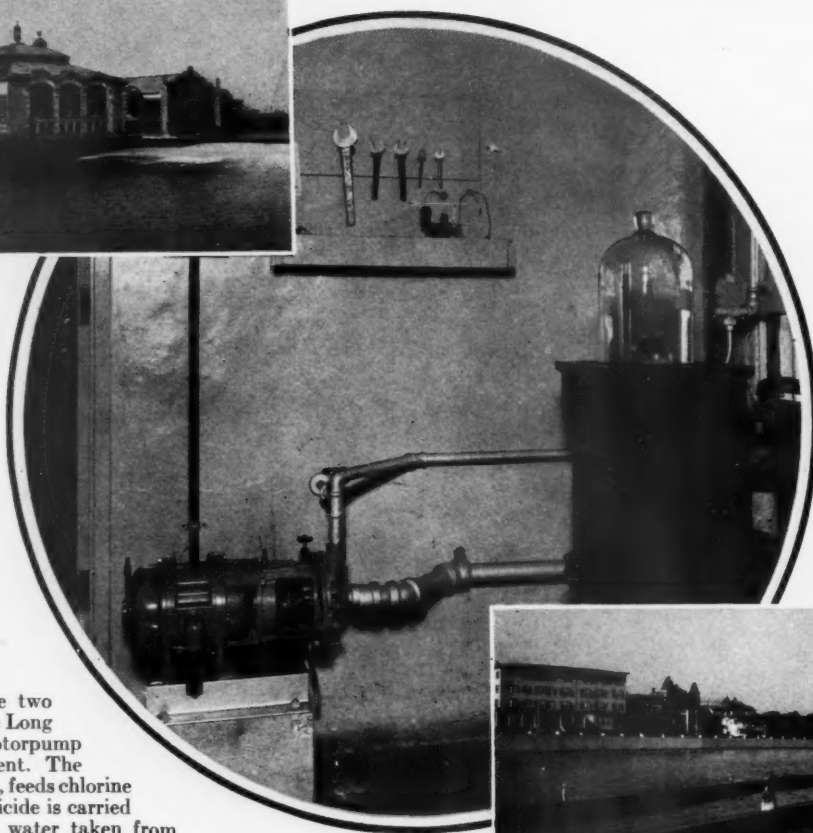
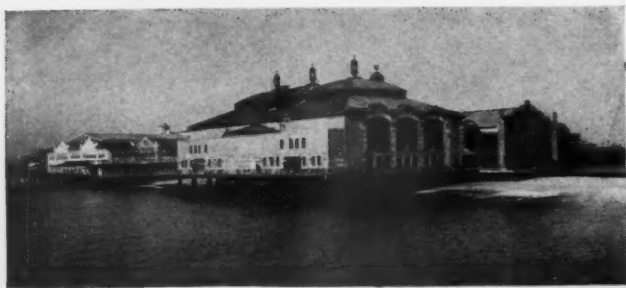
conserving it. However, in the case of the three municipalities mentioned, all water has to be purchased from a private concern, and the savings that have resulted from recirculating the effluent have proved sizable—in fact, they have been sufficient to pay for the additional equipment involved within a few weeks of operation.

The new method of chlorination was first instituted at Ocean Grove, an attractive community which adjoins Asbury Park on the south and which is under the control and management of the Ocean Grove Camp Meeting Association of the Methodist Episcopal Church. It was put to use there last year by A. J. Mount, operator of the sewage-disposal plant. Word of its success soon reached nearby Deal and Long Branch, whose authorities verified its efficiency and economy and then arranged for similar installations, which were made this summer.

The only equipment required is a pump for recirculating the effluent, together with the necessary piping. In the original installation at Ocean Grove, Mr. Mount selected for this service a Cameron "Motorpump." This unit is especially suitable for the purpose because it is a compact, small, efficient, and reliable pump with built-in motor and few wearing parts. Because of the successful performance of this unit, similar ones were installed at Deal and Long Branch when those communities changed their plants to operate under the new system.

Ocean Grove has a normal population of 2,000, but swells numerically each summer through the visitation of attendants at the camp meetings and casual visitors who come for the cooling sea breezes and the bathing. On some days there are as many as 125,000 persons there. The quantity of sewage that the plant is called upon to handle varies greatly, but the average is around 400,000 gallons a day. The sedimentation tanks, in the form of elongated concrete channels, are located underground.

The tanks provide for a detention of all sewage for from 20 to 30 minutes. The effluent leaves the tanks by way of a weir, and it is just short of this discharge that a portion of it is taken out for recirculation. The pump is housed at a point 15 feet higher than the intake, thus imposing a suction lift of that distance, but it performs satisfactorily under these conditions. The pump is rated at 20 gpm. against 100 feet of head. It is driven at 3,500 rpm. by a 1½-hp. General Electric



### CHLORINATION APPARATUS

The central picture shows one of the two Wallace & Tiernan chlorinators in the Long Branch plant and the Cameron Motorpump which recirculates some of the effluent. The chlorinator, with the bell jar at its top, feeds chlorine at a predetermined rate. This germicide is carried into the raw sewage in a stream of water taken from the effluent which remains after the solid portions of the sewage have been removed. The two smaller pictures are views made in this summer playground section of the New Jersey coast.

motor.

The chlorine is fed by a manually controlled Paradon chlorinator. The small quantity of water which is required for the tray of this machine is taken from a city supply tap, as it is desirable, although not necessary, to have perfectly clear water for this purpose.

The water rate at Ocean Grove ranges from 30 cents per 100 cubic feet down to 20 cents until 65,000 cubic feet has been used, after which the same rate-cycle begins again. Under this rate the sewage-disposal plant had a water bill of \$772 during the year prior to the change to the present system. Except for the few dollars expended for the supply of the chlorinator tray, all this expense has been eliminated—in fact, the total water bill for the five months of chlorination in 1932 was but \$9. As the cost of the pumping equipment was \$160, and the current for operating it cost \$105 for the season, it can be seen that the installation realized a tidy surplus during its first year of service. It was also determined that the consumption of chlorine was reduced somewhat.

The disposal plant at Deal is generally similar to that at Ocean Grove, and it also is underground. There are two sedimentation tanks, each consisting of two compartments having capacities of 1,600 gallons. The average quantity of sewage handled during the summer season is 600,000 gallons a day, and the maximum is around 900,000 gallons. The chlorine is introduced by means of two Wallace & Tiernan chlorinators. The "Motor-pump" installed is a Class IRV-2, which has

a capacity of 20 gpm. against 100 feet of head and is operated at 3,490 rpm. by a General Electric 2-hp. motor. As present operating conditions call for the use of only one chlorinator at a time, the pump is equipped with a small impeller designed to serve one machine. Should both chlorinators be needed at a later date, an impeller sufficiently large to handle the additional pumping load can be installed without the necessity of increasing the size of the driving motor. The effluent is recirculated through a 2-inch line. The pump suction is under a head of 18 inches. This plant was built in 1929, and the pump was installed in May, 1933. Officials of the borough state that the water bill for operating the plant formerly was about \$125 a month during the 5-month chlorination period. It is expected that recirculation of the effluent will eliminate virtually all this charge.

Long Branch is a larger community than either Deal or Ocean Grove. It has a greater permanent population than either of those places, and the sewage contains considerable industrial waste. Owing to these conditions, the sewage-disposal plant is larger than those previously mentioned and the treatment that it provides is more extensive.

The collection and disposal of sewage there is not a municipal function but is handled, instead, by a private organization, the Long Branch Sewer Company. This concern dates its existence back to 1886. It serves five square miles of territory through 50 miles of piping. The disposal plant was located when the community was small and when it was

possible to place it on the lowest ground in the city, thereby providing gravity flow from all points served. The company has made improvements in its disposal plant from time to time to keep pace with new developments as they arose. The facilities are modern in every respect, and during recent months a new 30-inch outfall line for discharging the effluent into the ocean was constructed at a cost of \$23,000.

Incoming sewage is pumped from wet wells into either of two 350,000-gallon open-air sedimentation tanks. These are equipped with Dorr traction clarifiers for continuous removal of the sludge. At 4-hour intervals the sludge is pumped to digestion tanks, where it is reduced to an inactive and inodorous condition. The gases which are generated during the digestion process escape through a 75-foot hollow, steel flagpole and are dissipated into the atmosphere. During the summer season the plant handles an average of 1,500,000 gallons of sewage daily.

Chlorination is accomplished by means of a Wallace & Tiernan feeder. The effluent recirculation pump is a Class IRV-2, rated at 40 gpm. against a 98-foot head. It is operated at 3,490 rpm., by a 2-hp. G. E. motor.

As the new arrangement has not been in operation for a full season, no figures are yet available as to the actual savings that it has made possible. It is estimated by William J. Emmons, manager of the Long Branch Sewer Company and chief operator of the disposal plant, that the water consumption has been reduced at least 75 per cent.





## Man Outstrips Nature in Producing Stone

**P**ROSPECTIVE home owners, no matter what may be their tastes, should have no difficulty these days in finding a building material to suit them or their purses. No longer do they have to confine themselves to lumber, brick, stone, and concrete: they can choose, besides, from among porcelain-enamel slabs, "Homasote"—a wall material that is furnished in panels one floor high, pressed-steel panels, enameled-steel panels, and "Rostone," which is the newest to be added to the list. All these have been already put to use in constructing private or detached dwellings that compare very favorably in cost with kindred houses built in the accustomed way. The savings are effected by the extensive use of fabricated materials—that is, structural units that come from the factory or mill precisely dimensioned and ready for assembling, thus greatly reducing the work to be done in the field.

Rostone is a synthetic stone that is the product of a group of chemical engineers. Its development dates back to about 1925, when David E. Ross, R. L. Harrison, and others set out to discover ways and means of permanently coloring processed stone. From these researches they turned their attention to Nature's methods of forming rock in an effort to simulate them in the laboratory. According to a paper presented by Prof. R. Norris Shreve, of the chemical engineering staff of Purdue University, at the recent annual meeting of the American Chemical Society, the investigators have succeeded not only in doing this but in working out a commercially practicable process whereby it is possible to produce stone from waste material at low cost.

Shale, alkaline earths, and quarry waste are the manufacturer's raw materials—the last-named being used as a filler. The shale,

in pulverized form, and a small percentage of the alkaline earths are thoroughly mixed in a moist state. Both the quarry waste and the coloring matter are added at this stage. The mass is then subjected to high pressure and, after molding, is "cooked" in a steam chamber for two hours. In less than a working day the basic materials are made to combine chemically into a homogeneous substance that has all the characteristics of Nature's stone which is millions of years in the making. It has been described as dense, weighing 130 pounds per cubic foot, and as having a close, uniform texture throughout. It has a minimum crushing strength of 8,000 pounds per square inch; is tough, hard, and highly resistant to wear; its absorption is low, approximately 8 per cent; bonds readily with mortar; and is free from chemicals that might induce corrosion of reinforcing metals. Severe exposure tests extending over a period of more than five years have proved the synthetic stone to be durable and weatherproof, as well as permanent in color.

Rostone comes in a wide range of grays, creams, buffs, browns, greens, blues, and reds which may be either flat, variegated, or blended to satisfy the taste of the architect or customer. It may also be given 2-tone effects when decorated variously by carving, sand-blasting, or the like. To do this, the mold is filled with the same mix as normally but of two contrasting colors or shades of a color, the lower or main body of the potential stone being of one hue and the upper and thinner layer of another. The thickness of the top layer depends upon the depth of the design to be cut in the surface. It is even possible to produce designs that have the appearance of being inlaid—the several colors used for the purpose extending from front to back of the block or slab.

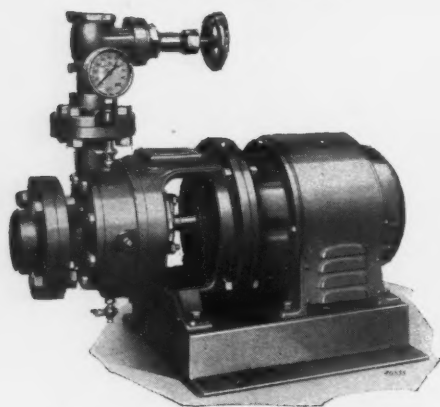
### MAN-MADE STONE

Slabs of gray-buff Rostone, manufactured to prescribed dimensions and colored to order, have been used in building the modern 5-room home at the left which is on exhibition at the Century of Progress Exposition in Chicago. Above are samples of the decorative panels with which the house is trimmed. They are red-brown in color and illustrate the artistic effects that may be obtained by sand-blasting (center slab) and by the use of colors. The ornamental design in the smaller panels is in gray-buff, green, and black, and has the appearance of inlay work.

As it comes from the mold the stone is ready for polishing, texturing, or otherwise finishing: no curing is required, no other subsequent treatment. It is said to take a lustrous polish and, because of the fineness of its texture, to require little handwork to bring out even delicate details of design reproduced by the mold. Much of the ornamenting is done by sand-blasting, which the plant is finding both practical and economical. The plant, which is now in production, is located at La Fayette, Ind.

Because the process lends itself to the making of structural shapes of all kinds that undergo no change in dimensions either during or after manufacture, there has been developed what is called the Rostone Method of Construction, which is exemplified in a 5-room house at the Century of Progress Exposition in Chicago. The walls, roof, flooring, stair treads, coping, fireplaces, etc., of this dwelling are of Rostone in various harmonious colors—the outer walls being constructed of 17x48-inch slabs 2 inches thick. All this material was delivered at the building site with the bolts cast in place and ready for fastening to a framework consisting of light-weight, structural-steel parts developed and fabricated for the purpose by the Indiana Bridge Company.

## PUMPS OF NEW DESIGN FOR BREWERY SERVICE



BREW-HOUSE AND CELLAR PUMP

A new line of brew-house and cellar pumps developed to meet the exacting requirements of brewery service is being marketed by Ingersoll-Rand Company, New York, N. Y. They are of the motor-driven, centrifugal type, the basic feature of the design being that the pump and the motor are combined to form one unit without a coupling. The motor and pump casings are connected by a single, rigid piece that insures permanent alignment and permits the pump to be operated in any position.

The motor rotor and the pump impeller are carried on one shaft, mounted on ball bearings, which is protected within the pump by a bronze shaft sleeve that continues through the stuffing box. This box is made extra deep as to accommodate plenty of packing. There are no pockets in the pump where liquid might collect; and all parts that come in contact with the wort or beer are made of the finest quality acid-resisting bronze.

These new pumps can be mounted in any desired position; and the discharge flange can be set in any one of four directions. They are easy to clean, simple in construction, and give long service with a minimum of upkeep. They are offered in a wide range of capacities and sizes to meet the various brewery needs. Both stationary and portable types are available.

At a recent meeting of the German Federal Forest Council it was brought out that the domestic timber reserves, suitable for the Bergius, Schulbach, and Scholler processes of wood saccharification, are capable of yielding annually products valued at approximately \$125,000,000—a potential industry that could absorb 400,000 of the nation's unemployed. According to the United States Trade Commissioner in Berlin, the Bergius method of extraction has reached a stage warranting the construction at Mannheim-Rheinau of a plant for the manufacture on a commercial scale of xylase and dextrose, both of which will provide fodder yeast, glycerin, acetone, and dietetic and pharmaceutical preparations. At the Scholler plant, in Tornesch, 96 per cent ethyl alcohol is being obtained from wood waste which has still other by-product possibilities.

## HEAT-RESISTANT PROTECTIVE COATING

TO COMBAT heat waste is the primary purpose, so we are told, of Stowell Protectocote, a compound which is suitable for the coating of all surfaces exposed to temperatures ranging from moderate to high. The new substance is said to be proof against acids, alkalies, most known gases, and fumes; will adhere to any surface; air-dries within an hour; and does not wear, chip, flake, peel, or disintegrate. It can be applied either by brush or by spray gun.

Stowell Protectocote is a product of carbon and silica; and is converted into a fluid paste by a patented chemical process that changes the fluxing elements into a viscous bonding compound. It is claimed to be admirably suited for coating boiler linings because it protects those materials against the harmful effects of excessive heat, remaining hard enough at high temperatures to resist abrasion and to prevent the adhesion of clinkers. By effectually sealing expansion and other cracks it also prevents the infiltration of cold air and the escape of hot gases. It is being used in power plants, paper mills, refineries, saw mills, foundries, ceramic plants, etc.

## NEW STAINLESS-STEEL ALLOY

FOLLOWING eight years of research, the Ludlum Steel Company has developed a new stainless-steel alloy that is said to be superior in a number of directions to other similar metals. An announcement to this effect has been made by the Associated Alloy

Steel Company of Cleveland, Ohio, which reports that the primary object of the exhaustive laboratory work was a stainless steel that could be heat treated and mill processed by the fabricator in much the same way and with the same tools as is mild steel. The product is known as Nevastain RA.

According to the manufacturer, the new alloy can be deformed hot without unduly straining rolls, forging presses, hammers, and heading and upsetting machines; and full ductility is obtained at normal annealing temperatures. The stainless steel is described as a metal that can be freely machined, sheared, punched, perforated, sawed, and drilled by the equipment ordinarily used for such work.

## SPARK-PLUG CLEANER

A BRITISH concern has put on the market a neat little device for cleaning spark plugs that operates on the sand-blast principle. It consists of a small metal cylinder in the top of which is a threaded opening into which the spark plug is screwed. The scouring is done by a special compound which is placed in the container and applied with air under pressure. The air is admitted through an opening in the bottom of the cylinder—the line being connected by means of a press-on Schrader chuck or by a lever cock. The latter is preferable for use in garages and shops where compressed air is required for different purposes. The device is mounted on a stand that can be fastened to a work bench or other convenient place.



AERIAL TRAM EXPRESS

The accompanying pictures show two diverse methods of transportation that were used to move portable compressors to high-altitude locations during the construction of the St. Gothard Road in Switzerland. The equipment had to be delivered at points about 8,000 feet above sea level, and the journey involved a considerable climb through some of the most rugged country in the Alps.

The machines were dismantled sufficiently to enable laborers to carry the several portions partway. Over the final stretch of the route they were conveyed by aerial tram-



way. The view in the circle shows the roof of a portable about to start the skyward trip. In the other picture human pack horses are arriving at the lower terminal of the tram with the air receiver of a portable. The tramway cable can be seen extending up the mountainside.